January 30, 1986

SUMMARY

Hyde Park Landfill

Section 10 Monitoring Program Reassessment and Section 11 Monitoring and Treatment of Collected Liquids

Section 10 - Monitoring Program Reassessment

Monitoring needs for a remedial program can change over time as more information is gathered and the remedial systems affect the local groundwater movement. Although reassessment of the monitoring program was not included in the original Hyde Park Settlement Agreement (April, 1982), monitoring requirements described in the Hyde Park RRT Program shall be reassessed periodically to insure that the monitoring programs are sufficient as we gather more data describing the effects of Hyde Park Landfill remedies.

The monitoring programs described in the Stipulation shall be periodically reassessed beginning one year after initiation of the APL Plume monitoring for the Lockport Bedrock RRT System. The reassessments shall evaluate the number and location of sampling points, the sampling frequency, the chemicals to be analyzed for, and the control/action concentrations specified for such chemicals.

These reassessments will allow the monitoring systems to be modified to accurately monitor the conditions present at the site.

Reassessment allows for more stringent controls to be placed on the Hyde Park remedial programs if further information makes more stringent controls necessary to properly protect public health and the environment. In addition, reassessment provides for evaluation of any part of the remedial activity in response to new data on changes in conditions in the area impacted by the Landfill.

Section 11 Monitoring and Treatment of Collected Liquids

Large volumes of contaminated liquids, both APL and NAPL, will be collected by the remedial programs. There will be different levels of treatment required based on the degree of contamination and the method of discharge of the treated groundwater into the environment.

Most aqueous phase liquids (APL) (all overburden APL, all APL within the NAPL plume collected by the NAPL plume containment system, and up to 15 gallons per minute of APL from the APL plume containment system) shall be treated at an on-site treatment facility to the levels presented in Addendum I, Paragraph E of the original Settlement Agreement (available at the EPA Hyde Public Information Office). These levels meet State Pollution Discharge Elimination System (SPDES) Discharge Limits therefore these liquids may be discharged directly to the Niagara River.

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Any APL in excess of 15 GPM collected by the APL containment system shall be treated to reduce the amount of chemicals entering the Niagara River to levels below action levels set to protect public health and the environment. These liquids may be discharged in two ways: 1) they may be reinjected in the bedrock APL plume into bedrock formations which assure no migration to the Gorge Face as a seep, or 2) they may be discharged in the sanitary sewer system of the City of Niagara Falls for further treatment provided such discharge does not interfere with city treatment plant operations or violate any applicable requirement of law concerning discharges to the sanitary sewer system.

In addition, a portion of the APL collected by the NAPL Plume Containment System (Chapter 4) will be reinjected into and recirculated within the NAPL plume in order to increase the amount of NAPL removed from the bedrock. This portion of the APL will not receive the treatment described above, but will be kept within the NAPL Plume Containment System and will not present an endangerment to the environment or public health.

Non-aqueous phase liquids (NAPL) collected by these systems will be incinerated off-site. It is important to note that the Stipulation does not require the installation of the remedial systems unless there are approved facilities to incinerate the NAPL (except for the APL & NAPL Plume Refinement Survey, the Gorge Face Program and Community Monitoring Program).

In addition to the capping requirements in the original Settlement Agreement, OCC has agreed to cover the landfill with a cap that includes a plastic membrane. The installation of the plastic membrane will greatly reduce infiltration of rain and melting snow. By reducing infiltration, the tendency for APL and NAPL to migrate out of the landfill will be reduced.

Prior to final capping of the landfill site, spent media (carbon from the treatment facility) which cannot be regenerated, or any other semi-solid or solid residue resulting from the storage or treatment of liquid collected by this remedial program, can be disposed at the landfill.

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SUMMARY

Description and Explanation of

Hyde Park Requisite Remedial Technology Program

Gorge Face Program

January 30, 1986

SUMMARY

Hyde Park Landfill
Requisite Remedial Technology (RRT) Program
Section 7.0, Gorge Face Seep Program &
Appendix A, Gorge Face Remedial Program

Introduction:

Chemicals from the Hyde Park Landfill have migrated with the bedrock groundwater and surface water runoff from Bloody Run Creek to the Gorge Face. This chemically contaminated groundwater seeps out of the Gorge Face and contaminates soil. A government team inspected the Gorge Face in July, 1985 to identify flowing seeps, wet areas and areas within the Bloody Run drainage area (at the Gorge Face) which may have been impacted by the Hyde Park Landfill. The area inspected extended from the PASNY parking area fence (at the end of Lower Access Road) to the Garfield Avenue storm sewer outfall. The identified areas are shown on the attached Figure A which is from Appendix A of the Gorge Face Remedial Program. The original settlement agreement provided a prescribed remedy which only addressed the Gorge Face soil contaminated by Bloody Run.

Purpose:

The purpose of the Gorge Face remedial program is to eliminate or minimize human exposure to chemicals that have migrated from the Hyde Park Landfill in areas accessible to the public.

Remedial Program:

For each area identified during the inspection, a remedial action was prescribed based on potential health risk, public accessibility, worker safety and physical characteristics of the terrain. Generally, soil/sediment samples will be taken to determine whether the remedial action would require covering the area or soil excavation. The samples will be analyzed for the original Hyde Park Settlement Agreement's Soil Survey Parameters and the recently negotiated Gorge Face Soil/Sediment Parameters (see table A attached). One of the chemicals being measured is 2, 3, 7, 8 TCDD, which triggers action at a level of 1 ppb. This action level is the same as the 1 ppb action level of concern set by the Centers for Disease Control (CDC). Because people will not be exposed to the soils at the Gorge Face as frequently for as long a period of time or in the same manner as in the CDC estimates, the use of the 1 ppb action level provides a greater margin of safety for those that visit the Gorge Face. If any of the Soil Survey Parameters are found, but the Gorge Face Soil/Sediment Parameter Action Levels are not exceeded, the area will be covered. To the extent practicable, before the covering takes place up to 0.5. feet of soil will be removed to maintain the original contours of the land. This will result in the removal of soils containing chemicals. If any of the Gorge Face Soil/Sediment Parameter Action Levels are exceeded, up to one foot of soil will be

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excavated and the area covered with clean rock or soil, as appropriate. At some locations soil/sediment samples will not be taken, but the area will be covered or excavated based on previous data or the location of the identified area. All material excavated as part of this program will be disposed of at the Hyde Park Landfill prior to final capping of the Landfill.

As a result of the operation of the proposed APL Plume Containment System the flowing seeps will be dried up or the flow greatly minimized. As explained in the Bedrock Remedies Summary this APL Plume Containment System can not be implemented for several years (after the NAPL Plume Prototype System installation and testing). Therefore the Gorge Face Remedial Program calls for many of the flowing seep areas to be diverted or covered before the APL Plume Containment System is installed. This will eliminate or minimize potential exposure to the public. The Gorge Face remedial work will be initiated for all the identified areas (except for areas within the Bloody Run drainage area) as soon as possible after the effective date of the stipulation. Plans, specifications and protocols will be submitted by OCC on or before February 24, 1986. Remedial work in the Bloody Run drainage area at the Gorge Face will begin after the upstream work such as the Bloody Run capping or excavation work is completed because if the remedial work were performed earlier, the soil would be recontaminated.

The original Hyde Park Settlement Agreement included a requirement to clean the portion of the Gorge Face over which the Bloody Run Creek flows. The Gorge Face in the immediate vicinity of the Bloody Run Creek was to be cleaned by use of a "high-pressure water jet." Cleaning by means of the high-pressure water jet was to continue until the residual concentration of trichlorophenol and hexachlorobenzene was below 100 parts per billion, and the concentration of TCDD was below detectable limits.

After careful reconsideration, it appears that jet cleaning is not practical, nor is it a necessary part of a complete remedial program which is protective of public health and the environment.

The current remedial program developed for the Gorge Face is based upon the guidance provided by the Centers for Disease Control. Up to one foot of soils/rediments will be removed if the concentration of TCDD in such soils/rediments exceeds 1 ppb or if the action levels for other Gorge Face Soil/Sediment Parameters are exceeded. These changes were made to conform the Bloody Run remedial work with the more extensive Gorge Face remedial effort developed as a part of the Hyde Park Requisite Remedial Technology Program.

The program calls for annual maintenance inspections to ensure that the remedies are intact and effective. Also, a concurrent annual survey will be conducted to determine if any new flowing seeps or wet areas are present. Newly identified areas will be addressed in a similar manner as the originally identified areas.

The program also calls for the survey area to be extended upriver should the Aquifer (APL) Plume Definition Parameters be detected in any of the APL Plume Flux Monitoring Wells (located upriver from the Gorge Face Survey area and to the west and southwest of the Landfill near the Gorge Face).

TABLE A

9.6 SOIL SURVEY PARAMETERS

The Soil Survey Parameters and Soil Survey Levels are as follows:

Parameter	Soil Survey Level
Monochlorobenzene	10 ug/kg
Monochlorotoluenes	10 ug/kg
Hexachlorobenzene	100 ug/kg
2,4,5-Trichlorophenol	100 ug/kg

9.7 GORGE FACE SOIL/SEDIMENT PARAMETERS

The Gorge Face Soil/Sediment Parameters and Action Levels are as follows:

Parameter	Action Levels
2,3,7,8-Tetrachlorodibenzo-p-dioxin†	1 ug/kg
Polychlorobiphenyls as Aroclor 1248	25 mg/kg
Hexachlorocyclohexanes	106 mg/kg

† EPA Method of Analysis for chlorinated dibenzo-p-dioxins and dibenzofurans (Appendix X to 40 CFR Part 261, Federal Register, January 14, 1985).

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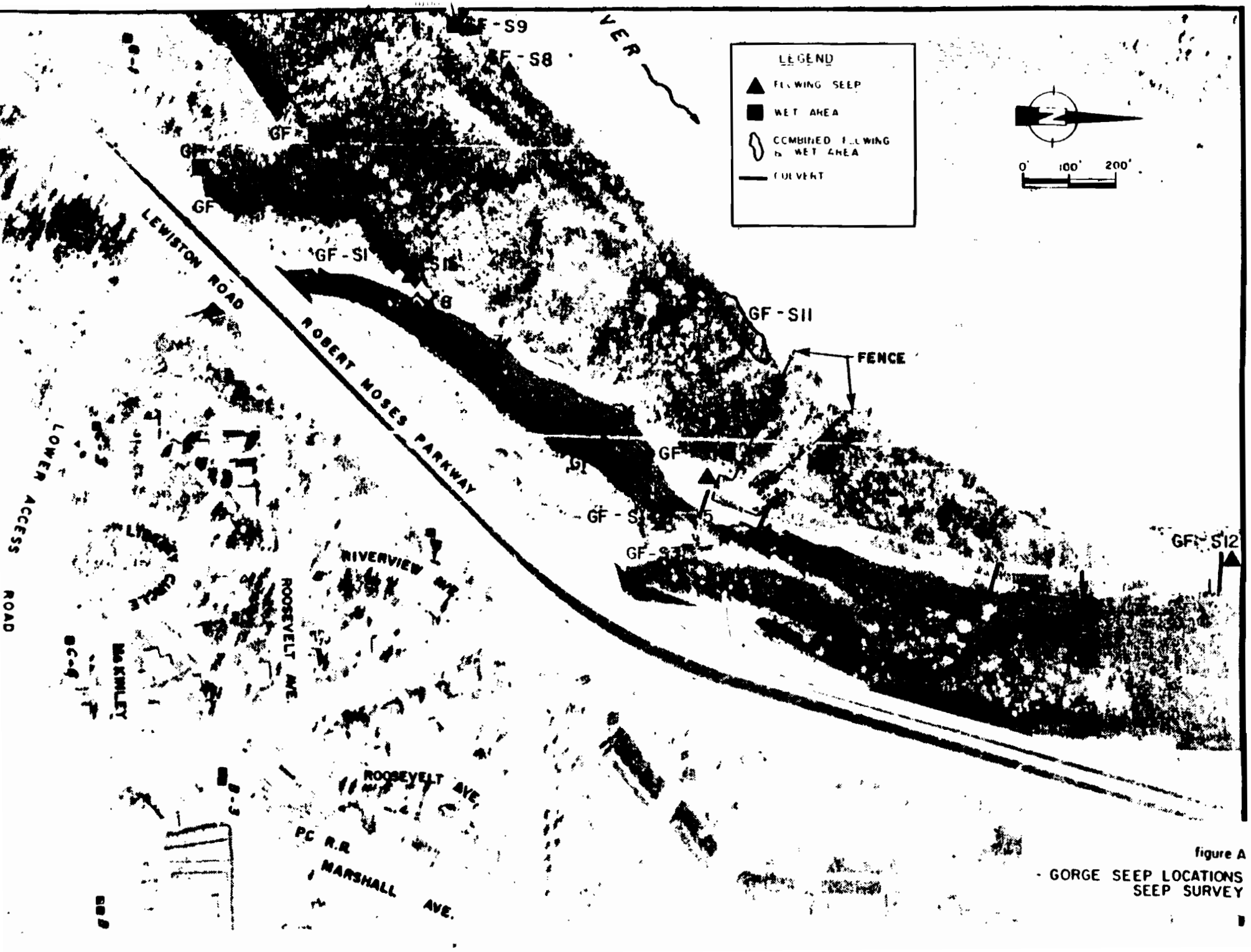

figure A

- GORGE SEEP LOCATIONS
SEEP SURVEY

January 30, 1986

HYDE PARK LANDFILL DOCUMENTS

Please take advantage of the EPA Public Information Office located in Niagara Falls at the Carborundum Center, Suite 530, 345 Third Street, 716/285-8842. All project documents are there for your review. The staff at the office will help you find information and documents you are in interested in and help you to interpret information that is difficult to understand.

The volume of information makes it impractical and impossible to cover all parts of the project in detail at public meetings, or in summaries. It is important for you to read some of the reports and documents yourself. Participating in public meetings and discussions and reading the project summaries will give you an overview and help you to understand what program aspects are particularly important. However, details and narrowly specific information will be more readily found by taking the time to read the reports and documents yourself. The following documents will provide you with a better understanding of the basis of the Hyde Park Requisite Remedial Technology Program.

- "Risks from Chemical Releases Associated with Proposed Excavation of the Hyde Park Landfill, Final Draft", prepared by R. Powell, R. Putzrath, S. Reith, J. Rodricks (ENVIRON) for USEPA, Region II, November 25, 1985.
- OCC Report, "Evaluation of Source Isolation - Bedrock Grouting as a Requisite Remedial Technology" prepared by Conestoga-Rovers & Associates Ltd., November 12, 1985.
- "Hyde Park Landfill Evaluation of Excavation Option" by Ben J. Mason, ETHURA, November 18, 1985.
- "Stipulation on Requisite Remedial Technology Program" Civil Action No. 79-989(C)., November 13, 1985:
  - Agreement Concerning Stipulation on Requisite Remedial Technology Program, Civil Action No. 79-989(C), November 26, 1985.
  - Memorandum of Understanding, Civil Action No. 79-989)C), November 26, 1985.
  - Overheads Used in Presentations, November 25, 1985.
- "Chemical Exposures from Fugitive Dust Emissions at Hyde Park" by Brian L. Murphy, November 22, 1985.
- Affidavit's, Civil Action No. 79-989(C) for:
  - Livia M. Benavides, October 28, 1985
  - Neil S. Shifrin, November 4, 1985
  - Charles R. Faust, November 1, 1985
  - Joseph V. Rodricks, December 11, 1985
  - Brian L. Murphy, December 13, 1985
  - Paul W. Jonmaire, December 20, 1985
  - Samuel J. Gianti, January 22, 1986
- Order Extending Public Comment Period, Civil Action No. 79-989(C)
- Fact Sheet on Remedial Actions, November 26, 1985

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- o News Release, November 26, 1985
- o "Summary - RRT Health and Safety Plans" December 31, 1985
- o "Summary - Description and Explanation of RRT Overburden Remedies" January 15, 1986
- o "Summary - RRT Community Monitoring" January 15, 1986
- o RRT Citizen Participation Program Schedule" December 31, 1985
- o "Summary - RRT - Gorge Face Program"
- o "Summary - RRT - Bedrock Remedies"
- o "Summary - RRT - Monitoring, Reassessment and Treatment of Collected Liquids

In addition there is a great deal of correspondence between the various parties to the agreement (EPA, DEC, DOH, DOL, OCC) and news articles concerning the Hyde Park Landfill that are available for your review.

Following is a listing of documents and specified pages separated by subject category:

Source Control

Stipulation pp. 15-23
Affidavit of Dr. Charles Faust p 43-46
EPA Excavation Reports - Dr. Mason
Dr. Murphy
Environ
Memorandum in Support of Stipulation pp. 15-24

Excavation

Stipulation pp. 20-22
Excavation Reports - Dr. Mason
Dr. Murphy
Environ
Affidavit of Dr. Shifrin pp. 35-36
Memorandum in Support pp. 15-24

Grouting

Stipulation pp.19-20
Conestoga Rovers Report on Grouting
Affidavit of Dr. Faust pp. 44-46
Memorandum in Support pp. 16, 20-21

Overburden RRT - Collection System

Stipulation pp. 24-36
Affidavit of Dr. Faust pp. 46-49, 68
Affidavit of Dr. Shifrin pp. 36-38

Community Monitoring Program

Stipulation pp. 122-139
Affidavit of Dr. Faust pp. 75-86
Affidavit of Dr. Rodricks pp.51-70
Affidavit of Dr. Shifrin pp 38-45
Affidavit of Dr. Murphy pp. 5-26
Community Monitoring Program Background
Memorandum in Support pp. 29-32

(hp doc 1/86)

Community Monitoring

Hyde Park:
Requisite Remedial Technology

January 15, 1986

Summary

Available data indicate that chemicals which have migrated from the Hyde Park Landfill have not reached homes in the Hyde Park/Bloody Run area and therefore that residents are NOT being exposed to these chemicals in their homes. However, to be sure that the potential for exposure remains unlikely and to provide for an early warning system to detect chemicals before exposure could occur, EPA/State and Occidental Chemical Corporation (OCC) have developed a residential community monitoring program.

If groundwater carrying chemicals from the landfill does reach residential areas where there is a potential for anyone in the community to be exposed, Occidental has agreed to take certain actions to prevent any such exposure. If, despite these actions, landfill chemicals dissolved in groundwater or in the form of vapor escaping from the groundwater do enter homes, residents are likely to be exposed through inhalation of the vapors or possibly through skin contact with water from a basement sump. Although the exposure to contaminants in either situation might be small, any exposure to landfill chemicals might represent an additional risk of an adverse biological response beyond that which would be expected from the resident's other exposure to chemicals in the general environment. If chemicals do reach homes, EPA/State will provide residents an assessment of what it believes to be the nature of the associated health risks, and, if necessary based on evaluation of the nature of the endangerment, will go to the Court to seek further remedial action to reduce exposure. EPA/State will consult with affected property owners (residents) before taking such action. In the event of such exposures, individual property owners have the right to seek further remedies, either legal or technical, from Occidental, if the individual so wishes.

Background

From 1954 until 1975, OCC, then known as Hooker Chemical and Plastics Corporation, disposed of approximately 80,000 tons of chemical wastes in the Hyde Park Landfill in the Town of Niagara. These wastes included chlorobenzenes, hexachlorocyclopentadiene (C-56) and trichlorophenols. Previous chemical analyses have identified 2,3,7,8-tetrachlorodibenzo-p-dioxin in the Hyde Park wastes.

In 1979, the United States and, in 1980, the State of New York sued OCC to clean up the on-site and off-site contamination resulting from leakage of chemical wastes out of the Landfill. Negotiations were held among all the parties and on April 30, 1982, a Stipulation and Judgment approving the Hyde Park Settlement Agreement was approved by the United States District Court.

The Settlement Agreement provided that OCC (1) conduct surveys and tests (Aquifer Survey Program) to determine how far and how deep groundwater (water present in soil or rock) had carried chemicals away from the Hyde Park Landfill and (2) assess ways to contain and/or clean up this contamination through the use of Requisite Remedial Technology (RRT). OCC completed this survey program in December 1983 and presented its findings to the federal and State governments. The findings demonstrated that there is a "plume" of chemicals in the groundwater migrating away from the landfill in two distinct liquid forms: non-aqueous phase liquids (NAPL) and aqueous phase liquids (APL). NAPL is composed of many chemicals that do not dissolve readily in water. It moves more slowly than APL through soil and rock and is more dense than water. APL also is composed of many chemicals; however, the chemicals are dissolved in groundwater and tend to be carried along with it. Because the APL plume contains chemicals dissolved in groundwater, this plume has spread further away from the landfill than the NAPL plume.

As required by the Settlement Agreement, OCC began a RRT Study in October 1983 to determine which remedies were most appropriate to clean up and/or contain the chemicals that had escaped and were continuing to escape from the Hyde Park Landfill. OCC submitted its RRT report to the governments (EPA/State) in May 1984 and the governments responded to the report in September 1984. Since that time, EPA/State and OCC have had many meetings to resolve outstanding issues and concerns raised by OCC's report and the EPA/State review of that report. The RRT ultimately agreed to by the parties is described in a document entitled Stipulation On Requisite Remedial Technology Program submitted to the United States District Court for approval on November 26, 1985.

This Stipulation is a very lengthy and complex document. It describes several specific programs designed to contain or collect Hyde Park chemicals including: site containment, health and safety, Gorge Face remediation and residential community monitoring.

Objective: Residential Community Monitoring Program

Although the available data indicate that residents are not being exposed to contaminated groundwater in their homes, the community monitoring program is designed to ensure that the potential for exposure is remote and to provide an early warning system to detect chemical contaminants before exposure can occur.

To design an effective program to monitor the potential for people living in the community to be exposed to chemical contaminants attributable to the landfill, the possible routes of exposure were considered. The possible routes of chemical exposure include the potential for migration of chemical contaminants into basements, either by infiltration of contaminated groundwater or by vapor migration. The infiltration of contaminated groundwater into basements can only occur if basement floors or sumps are in direct contact with a contaminant plume. Similarly, migration of contaminant vapors into basements can occur where basement structures are in an unsaturated zone (one that does not contain groundwater) which overlies or is adjacent to contaminated groundwater that contains high concentrations of volatile contaminants.

Early warning of the presence of chemicals will be provided by monitoring wells installed at eight locations in the Hyde Park/Bloody Run residential community. Locations for monitoring wells were selected on the basis of information presented in the "Hyde Park - Bloody Run Aquifer Survey" report of October 1983, an overburden thickness map prepared by OCC, and information collected by the New York State Department of Environmental Conservation during a door-to-door survey of area residences. Wells will be drilled into the overburden (soil) and the upper part of the bedrock (the rock immediately below the soil layer), in pairs of overburden and bedrock wells referred to as "well nests". The purpose of these well nests is to determine:

- (1) if Hyde Park chemicals have reached the groundwater in the community through the overburden or the bedrock and
- (2) if these chemicals have the potential to enter basements with groundwater or as vapors.

The monitoring areas are considered to be representative of the residential areas surrounding the Hyde Park Landfill. Monitoring in these areas on a continuing basis will provide an early warning of migration of the APL contaminant plume toward residential areas so that residents can be notified and all feasible actions taken to prevent or remediate such migration.

Methodology

The evaluation of the available data identified five areas for early warning monitoring (denoted I, IA, II, III and IV in Figure 1). Factors considered included the location of residences in and around the Hyde Park Landfill, the presence and depths of basements within the community and the proximity of the residences to the overburden and bedrock contaminant plumes. A total of eight pairs of wells will be located throughout these five areas (as shown in Figure 1) to determine if there is a potential for human exposure.

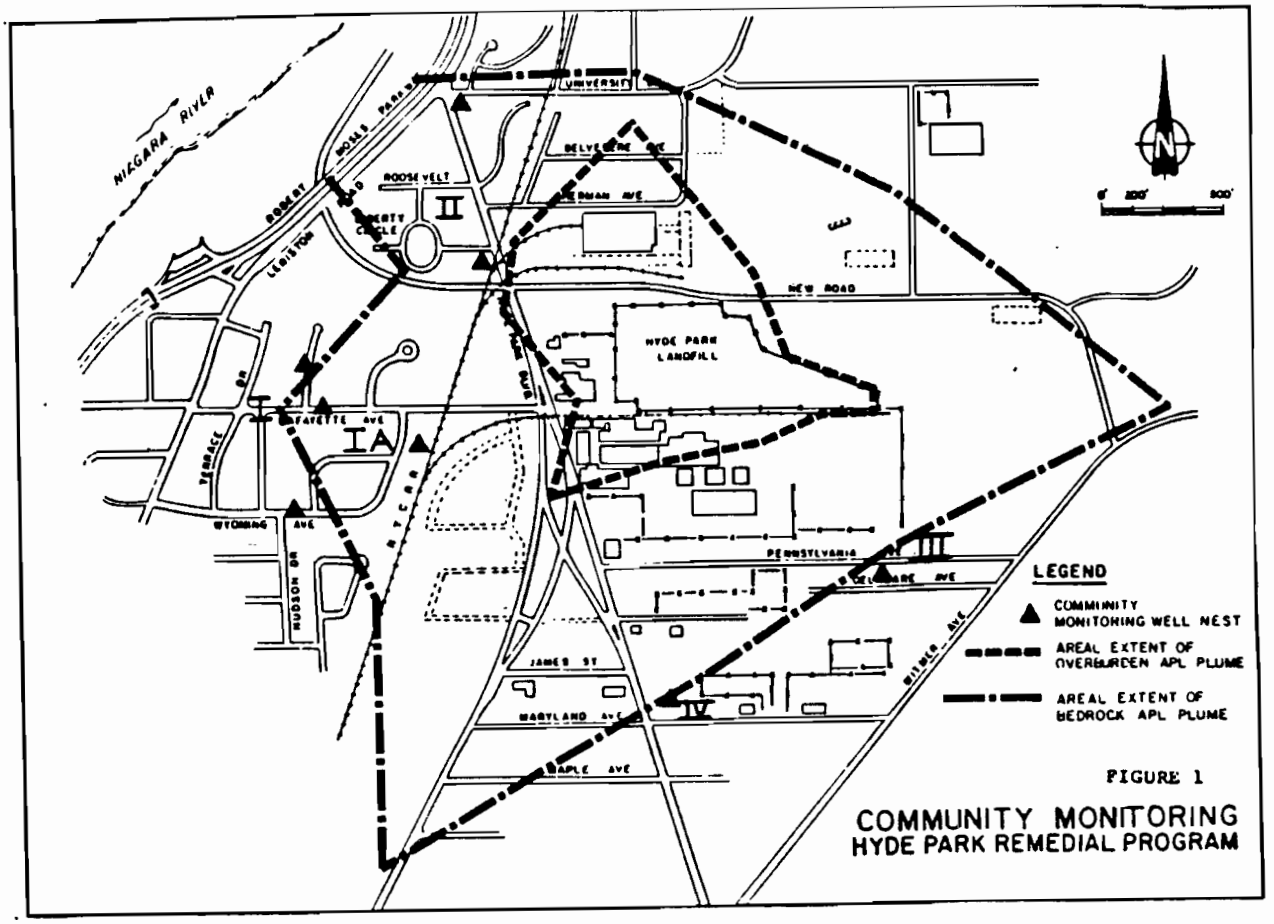


FIGURE 1

COMMUNITY MONITORING
HYDE PARK REMEDIAL PROGRAM

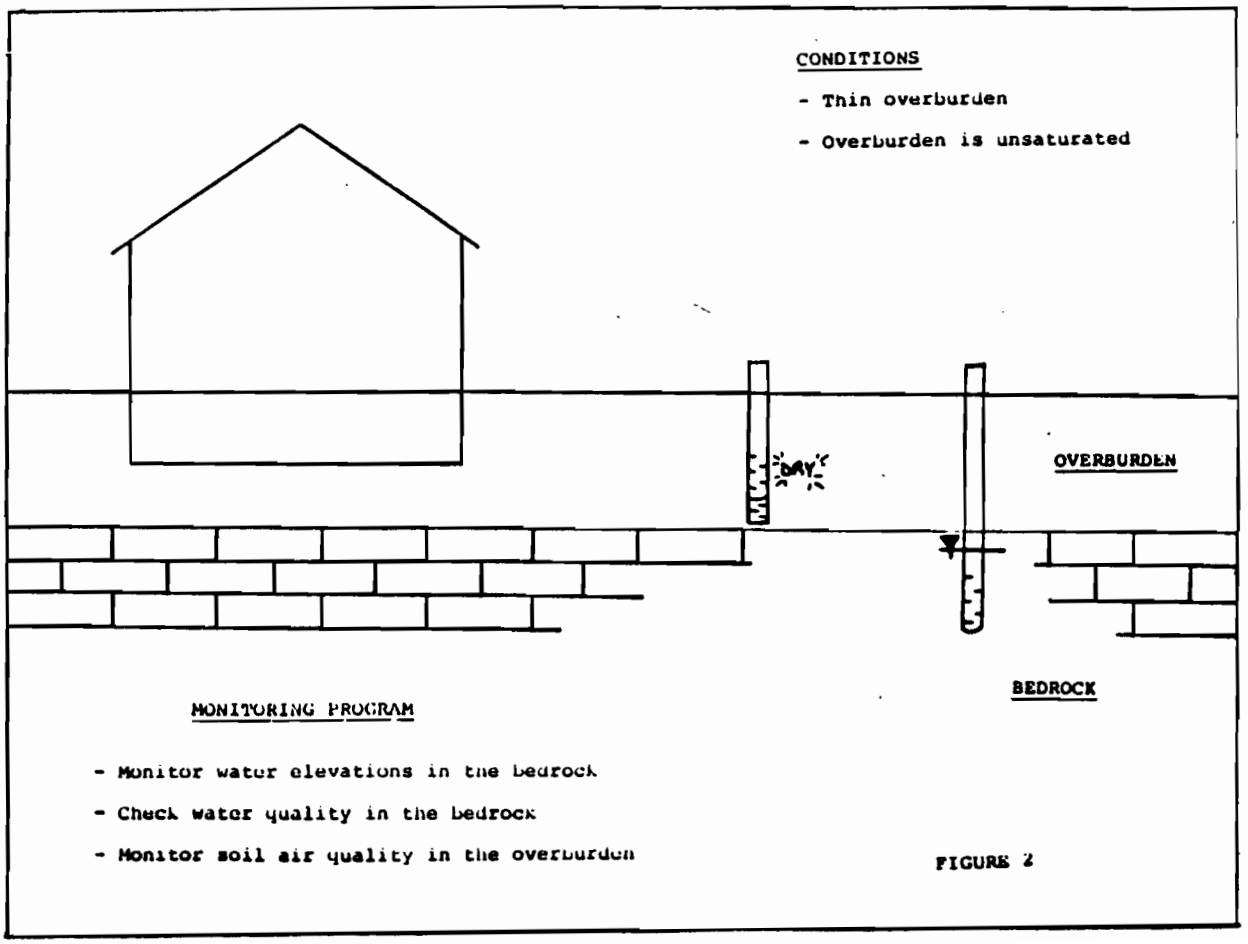


FIGURE 2

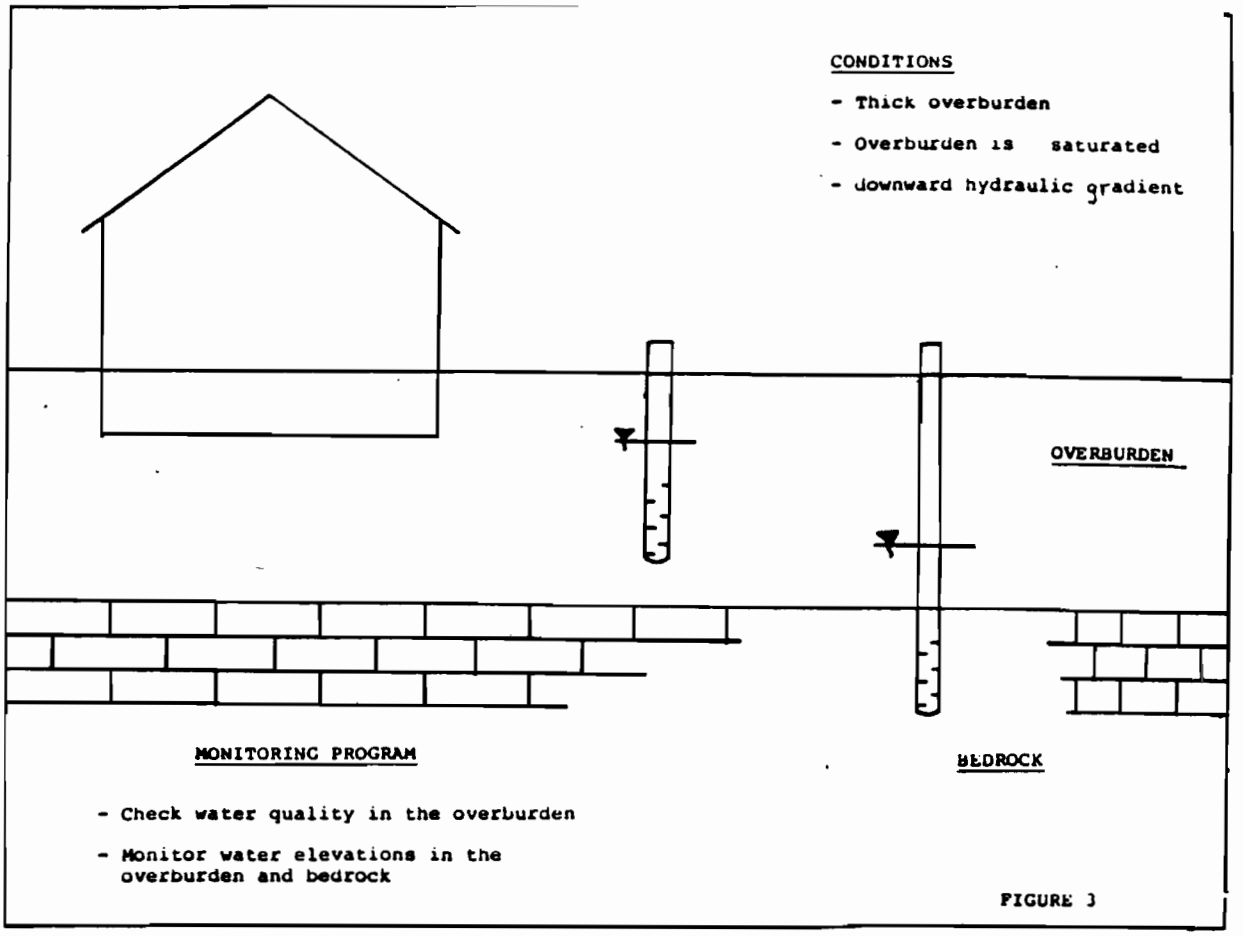


FIGURE 3

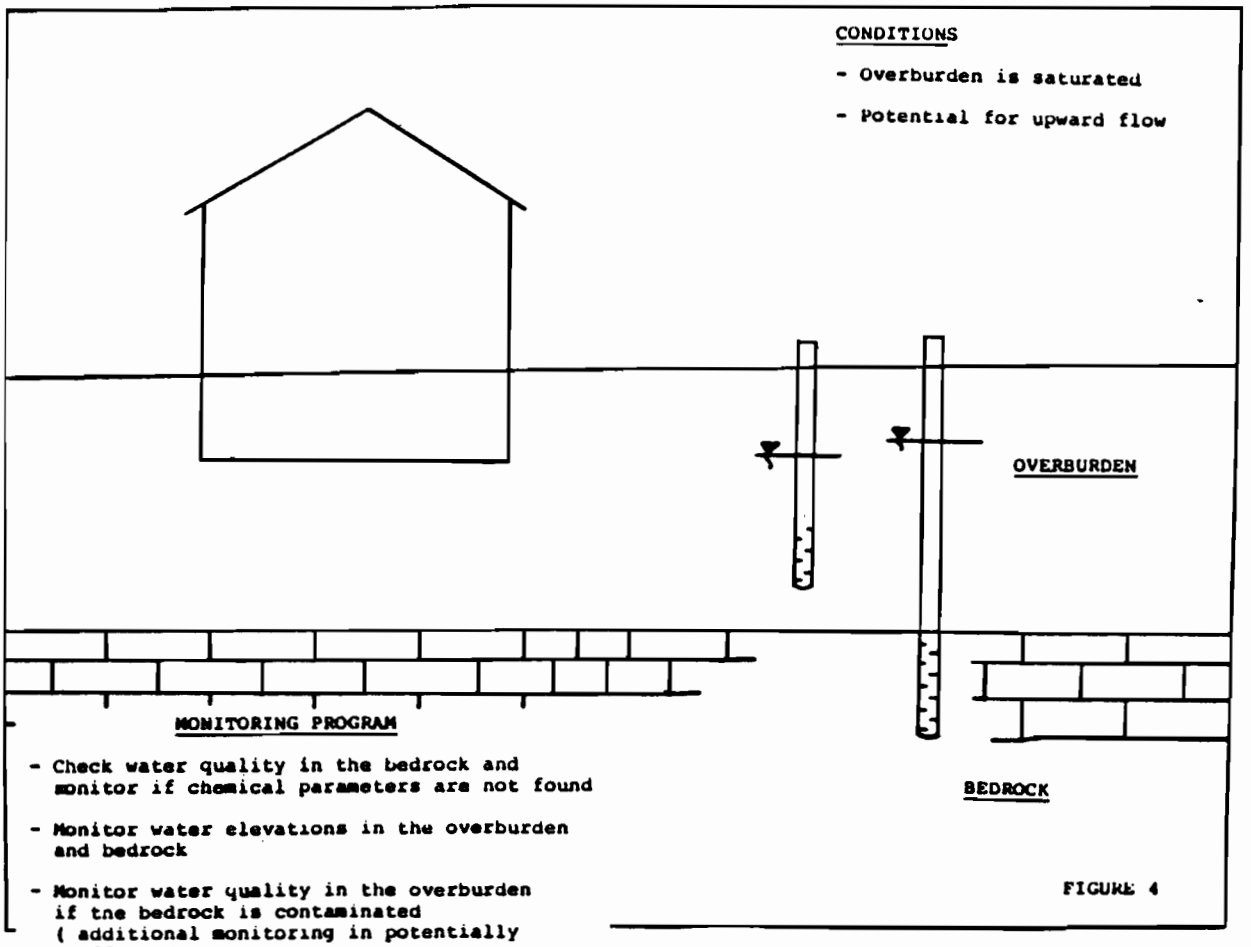


FIGURE 4

Following is the rationale used in selecting the locations and the types of monitoring that will be conducted:

Area I (see Figure 2).

This area lies beyond the western edge of the currently defined bedrock contaminant plume. Information from the aquifer survey indicates that the groundwater surface in this area is near the top of the bedrock. It is anticipated that, at least during certain times of the year, the overburden soil above the bedrock is unsaturated (i.e. contains no water). Though the two monitoring locations selected are immediately outside of the currently defined bedrock plume, the thin layer of unsaturated overburden (less than 10 feet) presents a condition for the potential (vertical and/or horizontal) migration of vapors toward basements from the underlying bedrock contaminant plume.

Area IA (See Figure 2)

This area is located immediately inside the western perimeter of the currently defined bedrock plume. The hydraulic characteristics are expected to be similar to those of Area I. However, the overburden in this area is thicker than in Area I (10 to 15 feet). Contaminants have been detected in zones which are below the top part (upper 15 feet) of the bedrock. Hence, it is not likely that vapor would migrate upward from contaminated groundwater in these deeper bedrock zones, through non-contaminated zones of saturated bedrock or overburden to reach basements. Nevertheless, because the overburden is expected to be unsaturated at certain times of the year, the monitoring program will be the same as defined for Area I and shown in Figure 2.

Area II (See Figure 3)

This area is located immediately northwest of the currently defined overburden plume. Although the overburden is 25 to 30 feet thick in this area, a house-by-house investigation by DEC staff found that some basements were actively intercepting overburden groundwater. Data from the aquifer survey in this area show that the elevation of groundwater in the overburden is higher than the elevation of groundwater in the bedrock. Since groundwater will move from higher elevations to lower elevations, the groundwater will flow downward from the overburden to the bedrock. It is also possible for the plume of contaminants in overburden groundwater to flow laterally as it moves downward into the bedrock. To ensure that lateral migration of the contaminant plume in the overburden does not pose a problem in the future, a monitoring location was selected between the currently defined overburden plume boundary and the residences in this area.

Another monitoring location in this area was selected east of Hyde Park Boulevard and just south of University Drive. The overburden in this area is approximately 20 feet thick with the ground surface sloping downward from west of Roosevelt Avenue toward University Drive. The overburden thickness at the low point in this area is less than 10 feet and the bedrock groundwater elevation is less than 10 feet below ground surface. A monitoring location was selected to evaluate whether the groundwater in this area has been or will be impacted. It is expected that the hydraulic characteristics of this particular location are similar to those at the other monitoring location in this area. Therefore, the monitoring program at this location will be as shown in Figure 3.

An exposure pathway in this area could exist if groundwater in the bedrock were to migrate upward into the overburden. This could occur if the elevation of groundwater in the bedrock were higher than the elevation of groundwater in the overburden or the elevation of basement floors/sumps in the community. To date, hydraulic situations conducive to upward groundwater flow have not been found in the vicinity of the Hyde Park landfill.

Area III (See Figures 2 and 3)

This area is located to the southeast of the currently defined bedrock plume in the immediate vicinity of residences located along Delaware Avenue. The overburden in this area is less than 10 feet thick and there is limited hydraulic information. If a portion of the overburden is saturated and the groundwater elevation in the overburden is higher than the groundwater elevation in the bedrock, then the hydraulic gradient is downward and the monitoring program will be similar to that described for Area II shown in Figure 3. If the overburden in this area is unsaturated for any time during the year, the monitoring program would be similar to that described for Areas I and IA and shown in Figure 2. Even though the overburden is thin, the potential for vapor migration is extremely remote because the nearest contaminated groundwater beneath this area is confined to zones deep (approximately 100 feet) within the bedrock. If different hydraulic conditions are found at the time of well installation or are encountered during certain times of the year, the monitoring program will be appropriately modified.

Area IV (See Figure 3)

This area is located immediately south of the currently defined bedrock plume. The overburden is 10 to 15 feet thick and is expected to contain a saturated zone. Therefore, the monitoring program would be the same as for Areas II and III where the hydraulic gradient is primarily downward as shown in Figure 3. Again, observation of different hydraulic conditions will mandate adjustments in the monitoring program.

Types of Monitoring Activities

When the overburden at a location is considered SATURATED, OCC must:

- o measure the height of the groundwater (elevation) in the monitoring wells and compare it to the depth of adjacent basement floors and sumps to determine if the groundwater is moving toward the basements; and

- o collect and analyze the groundwater in either the overburden or the bedrock monitoring wells for the Community Early Warning Chemicals. (The elevation of groundwater in the monitoring well and the presence or absence of chemicals determines the type and frequency of sampling for the location).

When the overburden at a location is considered UNSATURATED, OCC must:

- o measure the elevation of groundwater in the bedrock;

- o collect and analyze the groundwater in the bedrock monitoring well for the Community Early Warning Chemicals; and

- o collect and analyze a "soil air" sample from the overburden well for the Community Early Warning Chemicals.

Monitoring Frequency

Groundwater or soil air samples will be collected from community well nests quarterly and analyzed as quickly as possible so that results can be reported to the EPA/State within two weeks.

Most of the chemical analyses (except those of samples taken inside homes) will be performed by OCC. As a general matter, the hazardous waste laws (as well as EPA and State policy) require the responsible party to perform remedial actions (including sampling). As a practical matter, there are benefits to requiring OCC to perform such monitoring. OCC has qualified chemists and laboratories in Niagara Falls; therefore the analyses can be performed quickly. To ensure that such analyses are performed properly, EPA/State will approve a detailed program specifying how many samples must be collected and analyzed and will require that all analyses follow generally-accepted scientific standards. Additionally, every time a sample is taken (except for air samples), it will be split into two parts. EPA/State generally analyze about 20% of these "split"

samples and compare these results with the OCC results. Since OCC does not know which samples EPA/State will analyze, they must assume that any sample could be analyzed by EPA/State. Also, OCC is required to keep a portion of the chemicals extracted from each sample it takes (called an "extract") and EPA/State can request a portion of this extract to analyze. Finally, if the governments find that OCC has deliberately misreported data, OCC could be subject to sanctions by the Court.

Groundwater elevations will be measured at community well nests monthly for the first year and quarterly thereafter, except at one location which will be monitored continuously for five years to collect information about seasonal fluctuations in groundwater elevation.

Types of Samples and Chemical Analyses

Groundwater collected from wells in saturated overburden locations or from bedrock wells will be analyzed for the Community Early Warning Chemicals specified for water samples. These include: total organic halogen (TOH), chlorendic acid, benzoic acid, monochlorobenzoic acids, monochlorobenzene, monochlorotoluenes and monochlorobenzotrifluorides.

Chlorendic acid, benzoic acid, monochlorobenzoic acids, monochlorobenzene, monochlorotoluenes, and monochlorobenzotrifluorides were chosen because they are highly mobile, do not have a tendency to adhere to soil, are relatively stable (that is, they do not react with water or biodegrade easily), or are present in leachate, NAPL, or groundwater. These chemicals account for about 63% of the TOH and 46% of the Total Organic Carbon ("TOC") in the leachate and are major components of contamination of seeps at the Gorge Face. Monochlorotoluenes, monochlorobenzotrifluorides, and benzoic acid are also major identified components of NAPL.

TOH is also a Community Early Warning Parameter (CEWP). TOH measures all the organic compounds which contain halogens, that is, compounds which contain chlorine, fluorine, iodine, or bromine. This parameter overlaps somewhat with the specific chemicals because it will measure monochlorotoluenes, chlorobenzoic acids, chlorendic acid, monochlorobenzene, and monchlorobenzotrifluorides. However, TOH will also measure chloroform, chloromethane, 2,4,5-trichlorophenol, tetrachloroethylene, and numerous other relatively minor components of the APL plume.

A number of chemicals were considered, but were not selected, as Community Early Warning Parameters. Chemicals such as benzene, trichloroethylene, tetrachloroethylene, and chloroform were considered because they are toxic, relatively mobile, and present in the APL

plume. These chemicals were not chosen, however, because they are relatively ubiquitous in the environment and were not present at as high a level as were chlorendic acid, benzoic acid, or monochlorobenzoic acids.

For example, benzene is in gasoline, trichloroethylene is a widely used solvent, and chloroform is produced in the drinking water chlorination process and therefore would be in city water. Their use as early warning indicators was also considered redundant with the chemicals already chosen. Of the most abundant chemicals in the leachate and at the Gorge Face, only phenol was not chosen, primarily because it is subject to biodegradation, it is not as odorous as monochlorotoluene and monochlorobenzotrifluorides, and it is widely used and frequently found in environmental samples.

TCDD, PCBs, hexachlorobenzene and other more toxic chemicals were not used because they bind tightly to soil and therefore would not be expected to be found in the leading edge of the APL overburden plume. Thus, these chemicals would not act as early warning parameters. As the existing data indicate, the more mobile chemicals appear first and at higher concentrations in the leading edge of the APL plume, particularly in the overburden. By measuring those mobile chemicals, one can provide an early warning of the potential approach of the more toxic chemicals.

A smaller list of compounds, monochlorobenzene, monochlorotoluenes, and monochlorotrifluorides, was selected for air soil measurements, primarily because benzoic acid, chlorendic acid, and monochlorobenzoic acids are not extremely volatile or odorous and because of limitations in methods for measuring chemicals in soil air.

A modification of an existing, validated National Institute of Occupational Safety and Health ("NIOSH") air monitoring method will be used to be able to reliably and quickly measure these chemicals in soil air. Because additional field tests and laboratory validation will be necessary to verify that a 1 part per billion (ppb) detection limit is achievable with the modification of this method, air monitoring may not be initiated until some months after initiation of groundwater monitoring.

Chlorendic acid, benzoic acid, and monochlorobenzoic acids can be measured in groundwater using High Performance Liquid Chromatography ("HPLC") with a reliable detection level of 250, 100 and 100 micrograms per liter (ppb), respectively. These are reliable, generally achievable detection limits for this type of analysis.

The other chemicals on the CEWP list were Aquifer Survey chemicals and EPA/State have approved OCC's analytical methods at the lower 10 micrograms per liter (ppb) detection limits.

Early Warning Actions

If any Community Early Warning Chemical is found in either groundwater or soil air samples, OCC must:

- collect another sample (confirmatory sample) at the location or locations where any Community Early Warning Chemical(s) were found;
- promptly analyze the confirmatory sample and submit the results to EPA/State within two weeks so that EPA/State can notify the public and the Court of these findings;
- increase the sampling frequency at the well location(s) where chemical(s) were found; and
- initiate appropriate remedial action.

OCC Remedial Action

If the confirmatory sample verifies the presence of a Community Early Warning Chemical at any well within the eight monitoring areas, in each such area OCC must:

- assume the chemicals have migrated from the Hyde Park Landfill unless they can prove otherwise;
- determine the source of the chemical(s) and evaluate how far and in what direction the chemical could travel in the future;
- install new monitoring wells or undertake special tests of the soil and/or bedrock to obtain additional (hydrogeological) information;
- collect a water sample and perform a broad scan analysis to identify any other chemicals present in the water, including polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) using special gas chromatography/mass spectroscopy techniques; and
- promptly select and install an economically and technically feasible remedy to prevent or remediate the spread of Hyde Park chemicals into the residential community, unless the remedial action would require construction activity on residential property, require relocation of any residents, or interfere with a resident's use or enjoyment of his or her property. The time period for OCC to undertake this work is specified in the RRT Stipulation.

Additional Action

Should EPA/State determine that any remedies installed by OCC are insufficient to protect the residents from exposure to Hyde Park chemicals or chemical odors on their property, they would notify OCC and the public and propose alternate technologies or remedies to protect the residents from exposure. If OCC does not agree, the State and EPA will ask the Court to order OCC to install the alternate technologies or remedies or to offer appropriate remedial action to homeowners, including relocation if warranted by the circumstances. Of course, neither the State nor EPA will take any action that would limit a property owner's ability to seek any remedy.

EPA/State may ask the Court to order OCC to do additional testing in the community so that any changes in the environment that may result in exposure of residents to Hyde Park chemicals will not go undetected. This does not require OCC to do testing within a resident's home.

The State and EPA have entered into a cooperative agreement for the purpose of performing additional testing in homes or elsewhere in the Hyde Park/Bloody Run Community beyond that performed by OCC. The State will receive $250,000 for its immediate use to initiate additional sample collection and analysis or installation of new monitoring wells to assess the potential for exposure to the residential community if such monitoring is considered necessary when a confirmatory sample indicates the presence of a Community Early Warning Chemical. The monies spent by EPA/State for additional testing may be recovered from OCC if OCC agrees or is ordered by the Court.

Finally, the reassessment provision of the Stipulation (Section 10.0) provides EPA/State the opportunity to require additional monitoring wells, analysis of samples for additional or different chemicals, or other changes based on additional information gathered up to that time.

Additional Information

A more complete discussion of the Community Monitoring Program can be found in Section 8.0 of Stipulation On Requisite Remedial Technology Program, and the affidavits of Dr. Shifrin, Dr. Faust, Dr. Murphy and Dr. Rodricks, and EPA's Community Monitoring Program Background Document. These documents are available for your inspection at:

U.S. Environmental Protection Agency
Public Information Office
Carborundum Center, Suite 530
345 Third Street
Niagara Falls, New York 14303

Department of Environmental Conservation
Public Information Office
9820 Colvin Boulevard
Niagara Falls, New York 14303

Department of Environmental Conservation
Region 9 Office
600 Delaware Avenue
Buffalo, New York 14202

Copies of pertinent sections of the final RRT document or the Community Monitoring Program section can be requested by visiting the USEPA Public Information Office or by calling the office at (716) 285-8842.

SUMMARY

Description and Explanation of

Hyde Park Requisite Remedial Technology Program Overburden Remedies

January 15, 1986

I. Background

Chemicals disposed of in the Hyde Park Landfill are migrating from the site in the groundwater. Groundwater in the vicinity of the Hyde Park Landfill is found in two distinct natural systems. The first "groundwater system" is the groundwater which is found in the soil material which covers the bedrock, the "overburden". The second groundwater system is the groundwater which is found in the bedrock. (Please refer to Figure 1). Rain and water from snowbelt soak into the ground and this infiltrating water has saturated the overburden near Hyde Park. Generally, the overburden, at depths below 10 feet, is saturated. If a hole were dug or a well were drilled into the portion of the overburden which is saturated, groundwater will enter the hole or the well. The groundwater will fill the hole to a level which represents the level to which the overburden is saturated; this level is commonly called the water table (please refer to Figure 2).

Groundwater is capable of moving through the overburden. The direction in which groundwater moves can be determined by installing a series of monitoring wells. By measuring and comparing the level (elevation) of groundwater in the different wells, it is possible to determine the direction of groundwater movement. As with surface water, groundwater moves from areas of higher groundwater elevation to areas of lower groundwater elevation. Please refer to Figures 2 and 3.

Figure 3 presents a map of the vicinity of the Hyde Park Landfill showing the location of monitoring wells installed in the overburden. Lines connecting the overburden areas with the same groundwater elevation (groundwater contours) are shown on the map. By examining the groundwater contours it is possible to provide a better description of the direction of groundwater movement through the overburden. Groundwater flow directions are perpendicular to the groundwater contours, flowing from higher contours towards lower contours. In addition, much of the overburden groundwater flows down into the bedrock.

Rain and snowmelt which have soaked into the Hyde Park Landfill ("infiltration") have mixed with chemical wastes in the landfill. As infiltration mixes with the wastes, certain chemicals dissolve into the water. The groundwater in which the chemical contaminants have dissolved is commonly called Aqueous Phase Liquids, APL. The area of the overburden where APL is present is referred to as the Overburden APL Plume. The chemical wastes which are liquids themselves and which do not readily dissolve in water are commonly called Non-Aqueous Phase Liquids, NAPL. The area of the overburden where NAPL is present is referred to as the Overburden NAPL Plume. Both APL and NAPL seep deeper into the overburden and join the overburden groundwater system.

In October of 1983, Occidental Chemical Corporation submitted the results of an investigation to determine how far APL and NAPL had migrated from the landfill. OCC collected samples from 13 wells installed in the overburden. The samples were physically examined to determine if NAPL was present and samples were chemically analyzed to determine if Hyde Park chemicals were dissolved in the groundwater, i.e., if APL was present. Based on the results of the investigation, the extent of the APL and NAPL movement in the overburden was determined. (Please refer to Figure 4).

Chemical contaminants, both APL and NAPL, in the overburden groundwater system which have migrated away from the Hyde Park Landfill, if left uncontrolled, present a continuing threat to the health of those living and working near the Hyde Park Landfill and the environment. The purpose of the overburden remedial programs is to control the movement of the chemical contaminants and to remove a significant portion of these contaminants present in the overburden in order to minimize the threat posed by the APL and NAPL found in the overburden.

II. Description of the Overburden Remedial Program

The purpose of the Overburden Requisite Remedial Technology Program (RRT) is to contain the lateral migration of APL and NAPL through the subsurface soils in areas immediately around the landfill. The approach will be to refine the extent of APL and NAPL plumes within the overburden by installing additional borings and survey wells. Then, the Overburden Barrier Collection System (OBCS) will be designed, installed and operated to maximize the collection of mobile NAPL in the overburden. The OBCS will also collect a portion of the APL plume in the overburden. A performance monitoring system will provide data on the effectiveness of the OBCS and ensure that any APL and/or NAPL not contained by the OBCS will be contained by the bedrock remedies. In addition to these overburden remedies, OCC will address chemical migration via sewers from the landfill not addressed by the overburden remedial program (see "Remedial Program for Sanitary Sewer Lift Station College Heights Subdivision, April 1985"). If, through monitoring, it is found that modifications to the systems are necessary, the appropriate changes would be made.

All the elements of the overburden remedial program will be undertaken to minimize human exposure to chemicals in the overburden.

III. Refinement of the APL and NAPL Plumes

Additional soil borings and wells will be installed to refine the location of the APL and NAPL plumes in the overburden. EPA/State anticipate that the boundary of the APL and NAPL plumes may be closer to the landfill in some locations, e.g. north of the landfill in the Bloody Run drainage basin. This may be the case because the location of the APL and NAPL plumes was assumed to be half way between the last contaminated well and the first uncontaminated well located along a line going away from the landfill.

IV. What is the Overburden Barrier Collection System (OBCS)?

The major element of the overburden remedial program is the OBCS, a groundwater collection system designed to collect and intercept APL and NAPL moving away from the landfill through the overburden.

The OBCS consists generally of a trench that will be dug surrounding the portion of the Hyde Park Landfill in which chemical wastes were dumped. (Please refer to Figures 5, 6 and 7). The exact location of the OBCS will be based upon the results of the survey to refine the extent of the APL and NAPL plumes. (See Chapter III of this document).

As the trench is dug around the landfill, a layer of crushed stone will be placed in the trench. A perforated pipe (similar in concept to the drainage pipes used to drain farm fields and those placed around the foundations of homes) will be placed on the layer of crushed stone. The remainder of the trench will be filled with crushed stone or specially prepared sand.

APL and NAPL migrating away from the Hyde Park Landfill enter the sand-filled trench where they seep downward and enter the perforated pipe. In addition, a portion of the APL and NAPL which may have already migrated through the overburden further from the landfill than where the drain is located will be recovered. The liquids entering the perforated pipe flow through the pipe to concrete "pump chambers" from which the liquids can be removed by pumping. During design of the OBCS, consideration will be given to the use of lateral drains extended from the main drain to increase effectiveness of the system. Drain depth will be contingent upon depth of identified NAPL.

A "cap" will be installed over the landfill to reduce the amount of rain and snowmelt which soaks into the landfill. By reducing the amount of water which soaks into the landfill, the amount of APL generated in the landfill is reduced and the tendency for APL and NAPL to leave the landfill is also reduced. OCC has committed to include a plastic sheet (synthetic membrane) in the cap which will be placed over the landfill. Experience gained with a similar plastic sheet over other sites, for example the Love Canal Site, indicates that using such a sheet at Hyde Park should make the cap very effective in reducing the amount of water which enters the landfill.

The OBCS will not collect all the chemical contaminants which may be present in the overburden and already outside the OBCS. The portion of the chemical contaminants which will not be recovered by the OBCS (sometimes said to be "outside the zone of influence" of the OBCS) will migrate downward with the overburden groundwater and ultimately join the bedrock groundwater system. The bedrock groundwater system and the remedies to address the APL and NAPL found in the bedrock groundwater system will be discussed in another summary document.

Since the chemical contaminants present in the overburden and outside the zone of influence of the OBCS have a strong tendency to move downward and since the overburden APL plume does not appear to extend into residential areas, EPA/State concluded that people living near Hyde Park Landfill would not be exposed to the overburden APL plumes and therefore this portion of the APL plume would not present a risk to their health. Of course, a monitoring system must be installed to verify that the overburden APL plume does not expand into areas where people live. Please refer to Chapter V, Operation and Monitoring in this document and the Community Monitoring Summary.

V. Operation and Monitoring

The OBCS will be monitored to determine its effectiveness in meeting the objectives of the overburden remedial program. Eight (8) pairs of monitoring wells (16 wells) will be installed which are capable of providing both piezometric (water level) and water quality data. Well construction will be the same as in the APL plume refinement survey. Each new well will be tested to determine its adequacy for use in the program.

The water level monitoring data will be used to evaluate the effectiveness of the OBCS in collecting APL and NAPL. Immediately after the OBCS is installed and until one year after the monitoring well water levels stabilize, there will be continuous recorders on two wells and monthly water level measurements will be taken at all other wells. All gradients (gradients determine the direction of groundwater flow) observed will be evaluated quarterly. Following the first year after stabilization, monthly water level measurements will be made at all of the wells and the gradients observed will be evaluated quarterly. In addition to water level monitoring, visual and olfactory inspection of water samples for presence of NAPL will be conducted on a semi-annual basis.

If monitoring indicates than an inward gradient (groundwater moving toward drains) is not achieved, it may be necessary to redefine the limits of the APL plume and reevaluate the Community Monitoring Program. Any areas within the rerined APL plume boundary which constitute a threat to human health, will be dealt with througn alternate requisite remedies such as removal of hot spots or local lowering of the overburden watertable. Modification of the OBCS may also be necessary. If an inward gradient is not established after modification of the OBCS, OCC must undertake an additional RRT study.

The existing collection system and the OBCS are to operate for a period of 35 years following the effective date of the Judgement. Termination of these systems could occur before the 35 year period ends if one of the following conditions are met:

1. Over a period of four consecutive years, no specific chemical parameters are detected over 10 ug/l (parts per billion) in the collection system and termination of the system does not interfere with the operation of any other collection system. If chemical parameters are subsequently detected above 10 ug/l, the system would be put back into operation;

2. After 15 years from initiation of the OBCS, or 17 years from initiation of the Bedrock Purge Well System, which ever is later, it is determined by the parties or the court that operation of the OBCS is no longer requisite;

3. After five years following covering of the landfill, it is determined by the parties or the court that continued operation of the now existing drain system is no longer requisite.

Should the system operation be terminated prior to the end of the 35 year period, OCC will be required to maintain the system in working order up to the period of 35 years following the effective date of the Judgment. EPA/State will have the opportunity to demonstrate to the court that operation of the system should be resumed if necessary.

After 35 years following the effective date of the Judgment, operation of the system may be extended if EPA/State show the court that such an extension is requisite.

(east of Hyde Park Boulevard and south of New Road). APL and NAPL will be separated in a large tank where the NAPL, which is more dense than water, will settle to the bottom. The NAPL which is separated is to be incinerated. (Please refer to Chapter VII of this document).

The APL, once the NAPL has been removed, will be treated by use of activated carbon in a process similar to that shown to be effective at Love Canal and at OCC's Niagara Falls plant. OCC has informed EPA/State that OCC intends to complement the activated carbon treatment process by utilizing a specially suited biological treatment process. The specific details of the treatment processes will be submitted to both EPA and the State for review, comment, and approval. All such plans and specifications will also be made publicly available for review and comment.

Treatment by activated carbon provides for the removal of the toxic chemicals which have dissolved in the groundwater. The degree of treatment, which was established in the original Hyde Park Settlement Agreement, is shown in Table 1.

VII. Incineration of NAPL

The NAPL is composed of liquid chemical wastes. The original Hyde Park Settlement Agreement required Hyde Park NAPL to be destroyed through incineration or its performance equivalent. The "Stipulation on Requisite Remedial Technology Program" specified that this liquid waste must be incinerated. There is considerable experience with incineration technology both in this country and Europe which demonstrates that organic liquid wastes, including all the principal components of the Hyde Park NAPL, can be effectively incinerated in a manner which is protective of public health and the environment. However, at the present time there are no commercially operated incinerators which have all the necessary permits to allow OCC to dispose of the NAPL.

It is important to note that until OCC has access to a fully permitted incinerator, there is no place to dispose of the NAPL. Until fully permitted incinerator capacity is available for the destruction of NAPL, EPA and the State have agreed with OCC that remedial activities that result in the collection of NAPL should not be implemented. Therefore, the OBCS will not be installed until such capacity is available.

OCC has an incinerator in use at its Niagara Falls plant to destroy liquid organic wastes which are generated by normal plant operations. The incinerator has been in operation since the 1960's. Incineration experts at the Environmental Protection Agency and the Department of Environmental Conservation have carefully reviewed the design of the facility and the operating performance record. It is the opinion of these experts that OCC's incinerator is capable of effectively incinerating the Hyde Park NAPL. In order to verify this opinion,

and to determine if OCC's incinerator can meet all other requirements of State and Federal law and regulations, OCC will be required to conduct trial burns of relatively small amounts of organic liquids under carefully monitored conditions. These organic liquids will be similar to the NAPL and then the NAPL itself under carefully monitored conditions.

In addition to determining whether the OCC incinerator meets Federal and State technology requirements, EPA/State will carefully review the long term effects of residual emissions from the facility on public health and the environment before permitting its use to incinerate NAPL from Hyde Park.

The results of these "trial burns" will be evaluated to determine the effectivesness of OCC's incinerator.

VIII. Permits

Before OCC can incinerate NAPL on a regular basis, the existing permits for the incinerator must be modified. The modification of the permits to allow for the long-term incineration of NAPL will require the preparation of an Environmental Impact Statement and provide the opportunity for public hearings. The Environmental Impact Statement will address issues related to the trial burns as well as issues related to the long-term incineration of NAPL. When they are available, please take the time to study the Environmental Impact Statement and the results of the test burns and participate in any public hearings related to the permitting of OCC's incinerator. In this way, you will have sufficient information to participate in this most important decision in an effective way.

All remedial activities at the landfill are subject to state and federal review and approval prior to actual implementation. The stipulation requires that all substantive provisions of permitting requirements must be met, including an opportunity for public review and comment. EPA statutes and regulations and the National Contingency Plan specifically exempt onsite (incinerator is off-site and therefore will require all permits) remedial actions from the requirement to obtain Federal, State or local permits as long as the remedial work is performed pursuant to an administrative or judicial consent order. The State made a decision that, in this case, permits would not be required for on-site activities if OCC complies with all substantive requirements of the regulatory program. Imposing procedural requirements associated with obtaining permits would significantly and unnecessarily delay the implementation of on-site remedial activities at the Hyde Park Landfill and not add any substantive (i.e., health or environmental protective) requirements.

IX. Industrial Protection Program

It is known that the Hyde Park contaminant plumes in the overburden extend to areas below the industrial facilities located near the landfill. During July of 1985, representatives of EPA, the State of New York, OCC and the adjacent industries, conducted detailed inspections of the industrial facilities located within the overburden APL and NAPL plumes. During the inspection, locations within the industrial facilities were identified where employees might be exposed to Hyde Park contaminants present in the APL and NAPL overburden plumes. Specific remedial actions to eliminate the potential for exposure were identified. Such remedial actions include sealing drain covers, filling old sump pits, sealing the walls of active sump pits, and establishing health and safety

contaminants from the APL and NAPL plumes, they should inform EPA/State so that these areas may be considered for remedial action.

Land Use Notification

OCC is required to notify all property owners within the redefined boundary of the overburden APL plume and request that they contact OCC prior to initiating any subsurface activities within such areas. If OCC is notified of pending subsurface work, it is required to notify EPA/State of such work and OCC shall advise the affected parties as to the character of the area and what health and safety procedures should be utilized in performing such work. Such advice will be reviewed by EPA/State and supplemented, if necessary.

X. Source Control

Geologic conditons existing at the Hyde Park Landfill have allowed toxic chemicals to migrate from the site into the overburden (soil above the bedrock) and the underlying bedrock. The objectve of source control is to remove, to the extent practicable, mobile liquids (particularly NAPL) from the landfill in order to reduce the amount of downward chemical migraton.

The first phase of the Source Control program involves the installation of a prototype well system (two extraction wells) to test the effectiveness of a program to pump contaminants out of the landfill. If a reasonable amount of liquids, NAPL, can be recovered, then an operational program (six extraction wells) will be designed and installed.

The prototype program will allow for initiation of the project prior to final design and will provide information necessary to design the most efficient program for NAPL removal. Initiation of the prototype program will follow start-up of on-site storage and treatment facilities and approval of a facility for NAPL incineraton.

The Stipulaton provides for periodic reassessment of the operational program. This will include decisions as to whether or not more wells should be added and/or existing wells discontinued.

Initial evaluaton of four alternatves, lateral drains, grouting, excavation, and extracton wells, resulted in selection of extraction wells as the preferred technology for source control. Considerations given to groutng and excavation are presented in documents available at the EPA Public Information Office (see particularly Affidavit of Dr. Faust and Excavation Report). The feasibility of lateral drains can be better evaluated based on the results of operating the prototype extraction wells. Furthermore, the extraction wells can be installed sooner than a lateral drain if necessary and therefore the extraction wells were considered to be the preferred alternative.

Further evaluation of lateral drains, grouting and excavation shall be carried out if any of the following occur:

- if an operational system of extraction wells is not considered to be effective;
- if an RRT Study is necessary to address chemicals in the Rochester Shale;
- if an RRT Study is necessary to address chemicals found below the Rochester Shale; or
- it performance criteria for the Lockport Bedrock RRT System (Section 4 of the RRT Stipulation) are not met and correctve action is not effective.

An operational source control program involving one or more of these technologies wil be installed if it is determined to be requisite.

Operation of any present or future source control technology shall continue for 35 years unless otherwise determined to be no longer requisite. Operation may be extended if such an extension is necessary to protect human health and the environment. If the system is terminated, operations may be resumed if a party shows the court that such action is necessary.

Excavation was extensively considered during the development of the RRT (see Excavaton Report). At this time, EPA and the State have concluded that excavation is not the preferred solution for the following reasons·

Insert A

(1) the substantial health risks presented by excavation;

(2) the lack of available commercial landfills for reburial or permitted incinerators for destruction of the excavated material;

(3) the lack of reliable, fully tested dust and vapor procedures for a major excavation project to substantally reduce the health risks excavation;

(4) the costs of total excavation and reburial or incineration of the entire contents of the landfill would be extremely high (i.e., estimated between $300 million to over $3 billion); and

(5) in light of the above factors, and the opinions of EPA/State experts concerning the anticipated effectiveness of the selected remedies, EPA/State do not believe the governments could obtain excavation and reburial or incineration of the entire contents of the landfill at this time in litigation.

Additional detail regarding excavation can be found in the Excavation Report.

Excavation is required to be reconsidered if the initial remedies presented in the RRT document do not work or if NAPL is found below the Lockport bedrock formation and is not contained. It should be noted that even if excavation of the landfill occurred, all of the overburden remedies (except source control) and the bedrock remedies would need to be implemented and operated for a long period of time to address contamination that has already escaped from the landfill.

TABLE I

Parameter	Treatment Level	Sampling Frequency
pH	between 5 and 10	Daily Composite
Phenol	10 mg/L (1 mg/L two years after effective date of Judgment)	Daily Composite
Total Organic Carbon	300 mg/L corrected for methanol or 1000 mg/L uncorrected	Daily Composite
Trichloroethylene	10 ug/L	Weekly Composite
Tetrachloroethylene	10 ug/L	Weekly Composite
Monochlorotoluenes	10 ug/L	Weekly Composite
Monochlorobenzene	10 ug/L	Weekly Composite
Trichlorobenzenes	10 ug/L	Monthly Composite
Tetrachlorobenzenes	10 ug/L	Monthly Composite
Monochlorobenzotrifluorides	10 ug/L	Monthly Composite
Hexachlorobutadiene	10 ug/L	Monthly Composite
Hexachlorocyclopentadiene	10 ug/L	Monthly Composite
Hexachlorocyclohexanes	10 ug/L	Monthly Composite
2,4,5-Trichlorophenol	10 ug/L	Monthly Composite
Tetrachlorodibenzo-p-dioxins	as described in subparagraph B(1)(c)(i)	Semi-Annual Composite of monthly samples

HYDE PARK LANDFILL

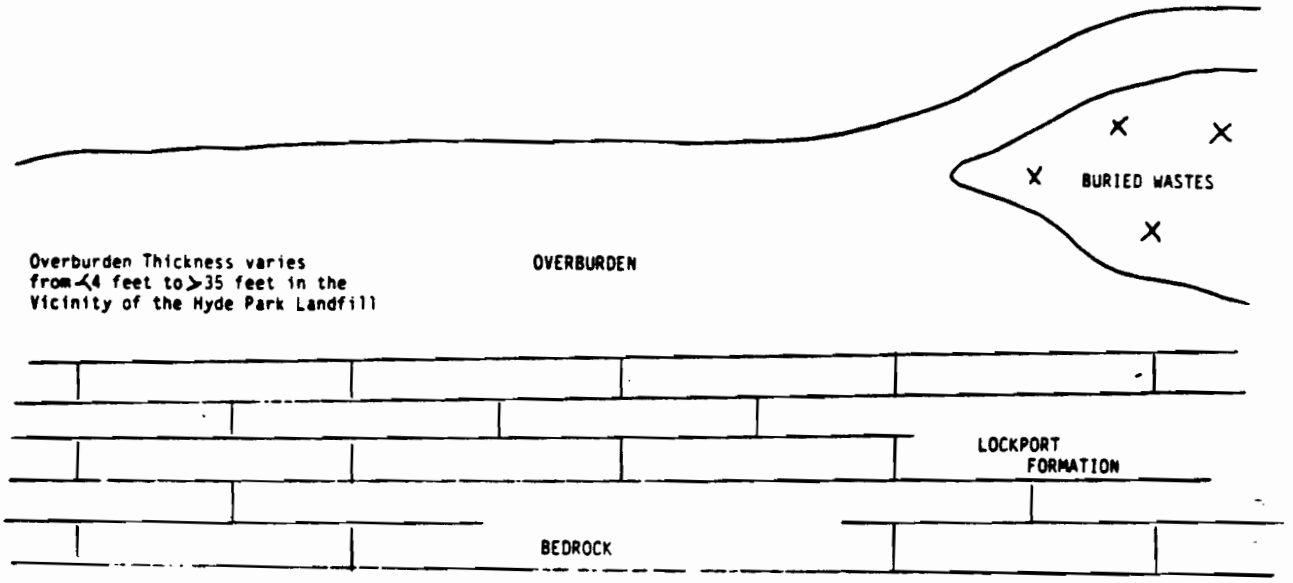
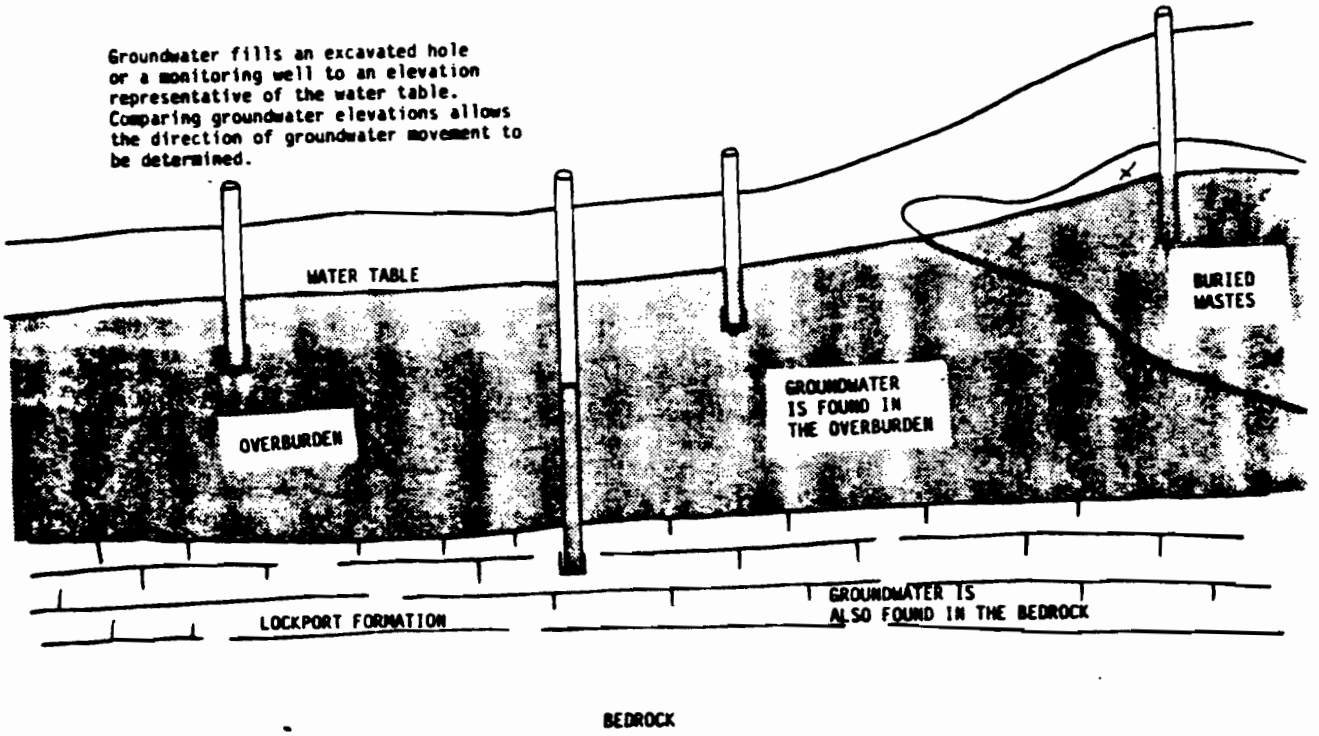


FIGURE 2

TYPICAL GROUNDWATER CONDITIONS



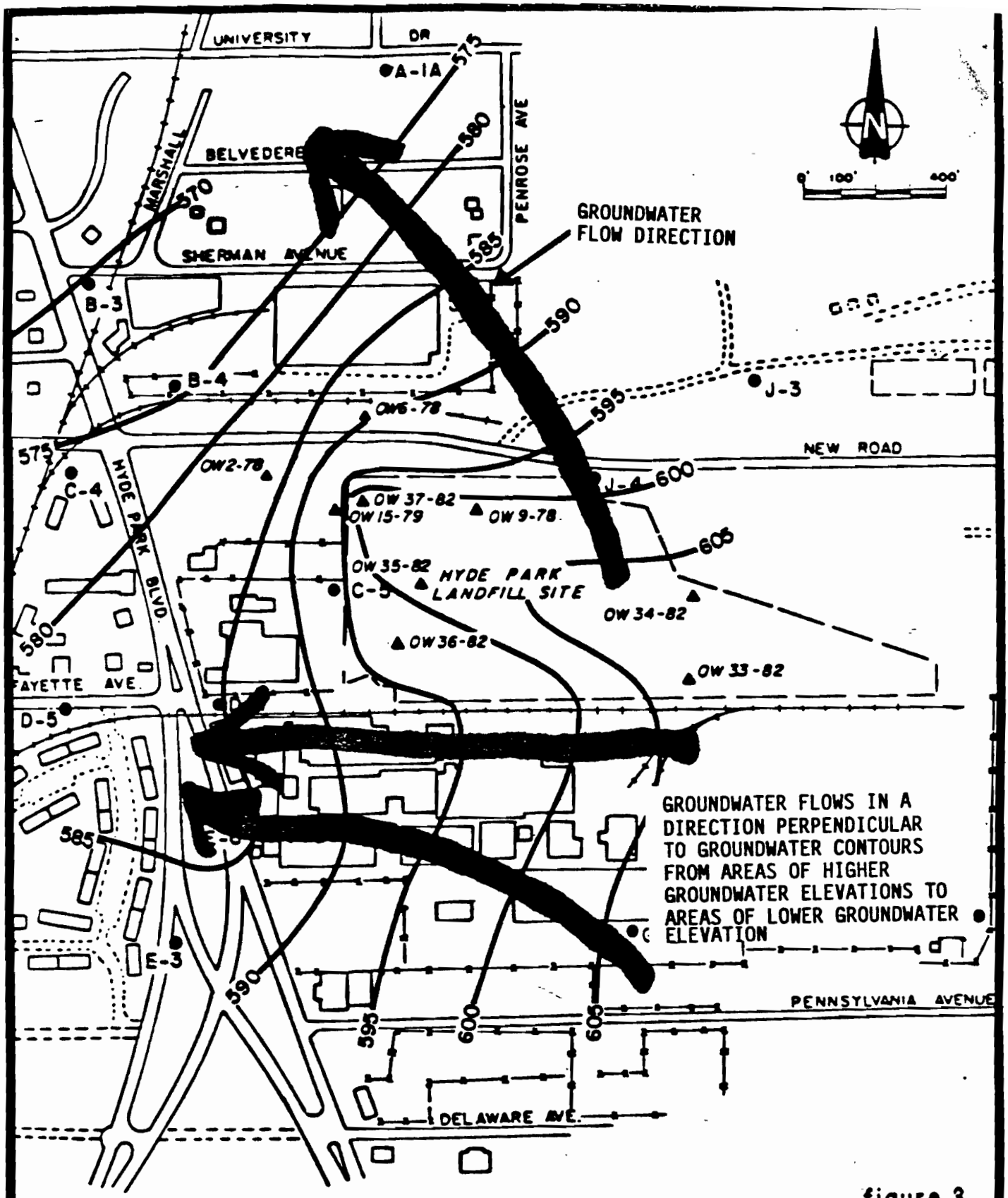


figure 3

LEGEND

- ▲ SURVEY WELLS INSTALLED PRIOR TO 1983
- ● SURVEY WELLS INSTALLED IN 1983
- —— GROUNDWATER CONTOURS (USGS DATUM)

CRA

OVERBURDEN GROUNDWATER CONTOURS AS MEASURED DECEMBER 21, 1983 HYDE PARK REMEDIAL PROGRAM

Occidental Chemical Corporation

1069-21/03/84

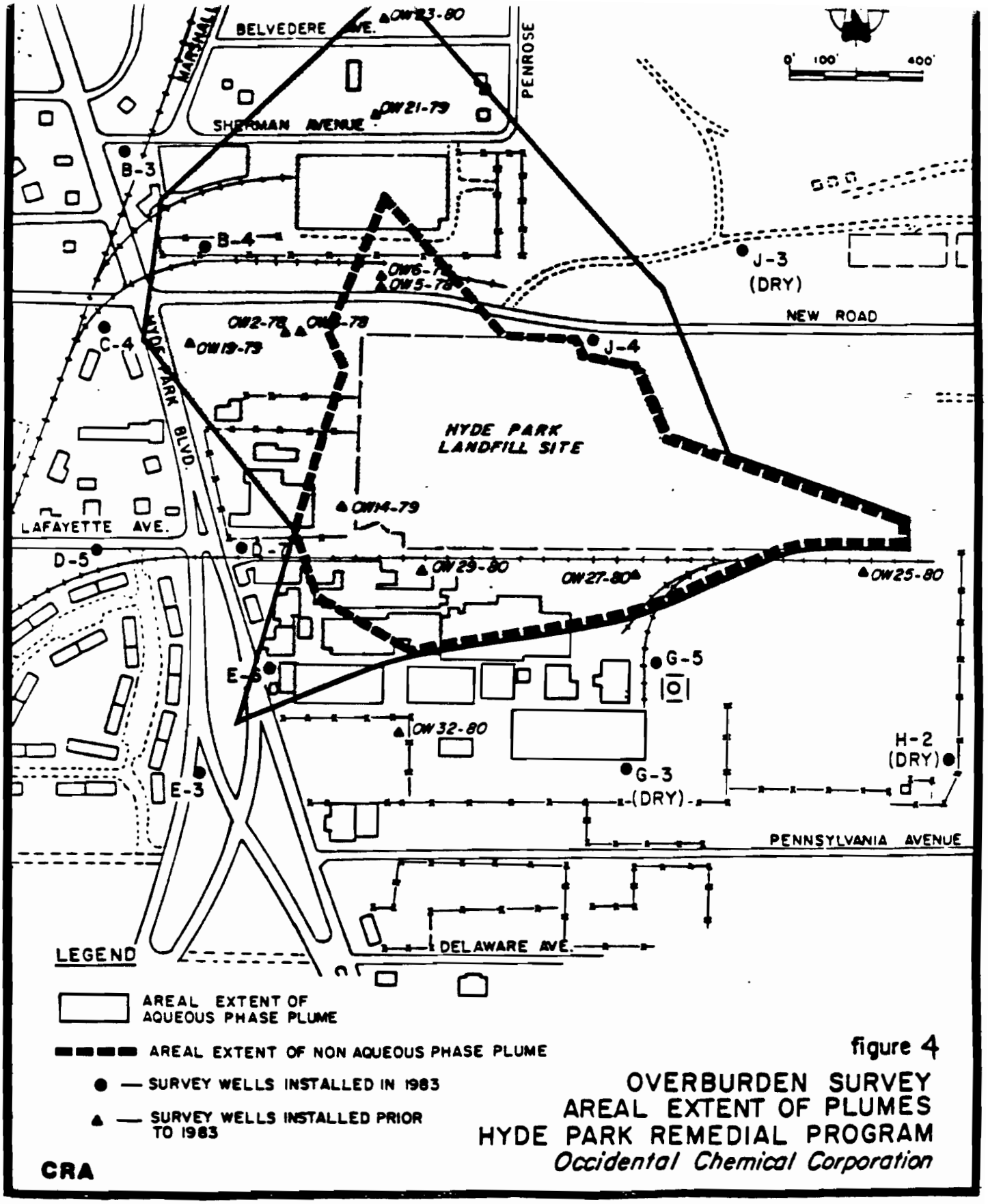
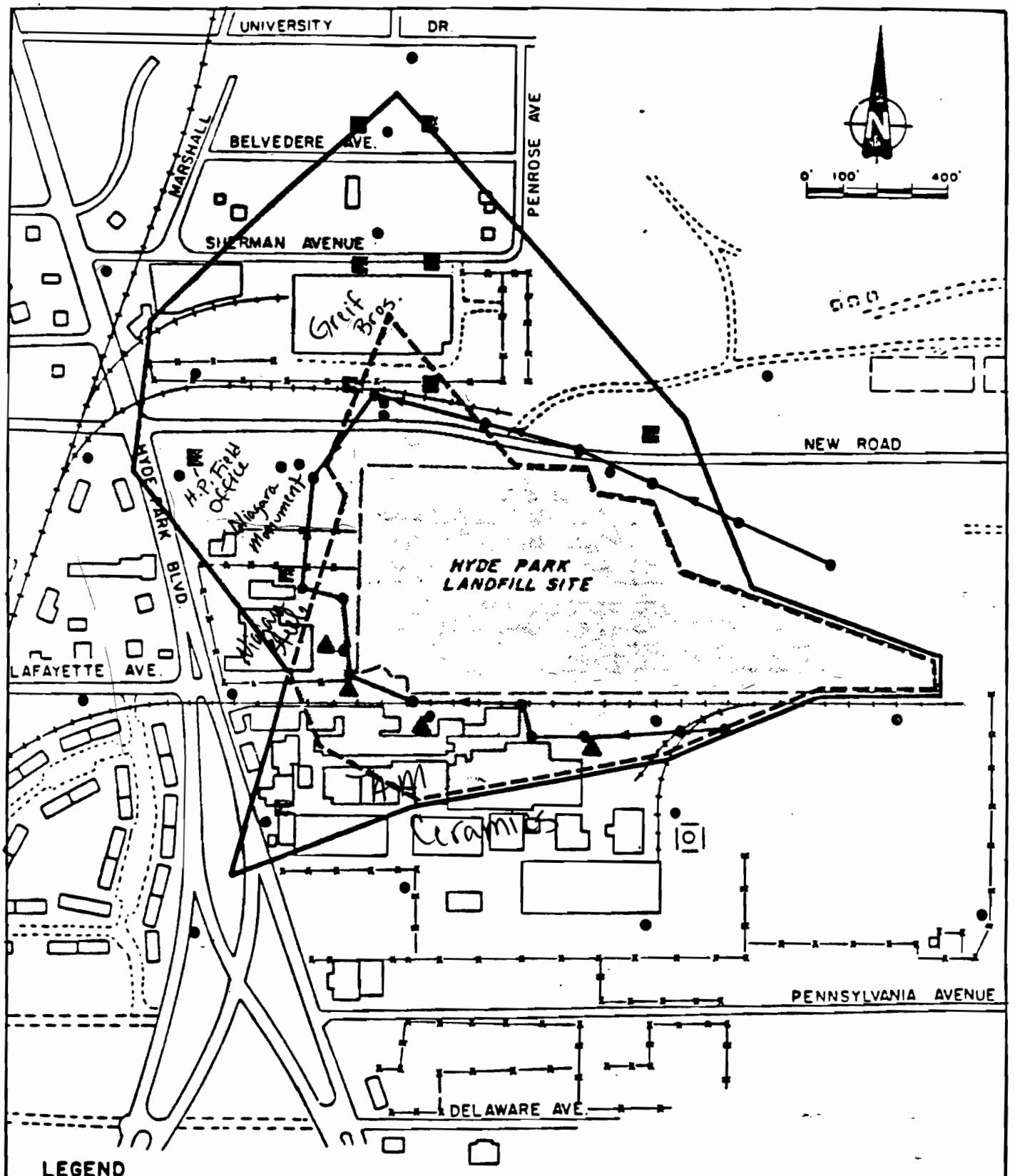


figure 4

OVERBURDEN SURVEY
AREAL EXTENT OF PLUMES
HYDE PARK REMEDIAL PROGRAM
Occidental Chemical Corporation

1069-21/03/84



LEGEND

- AREAL EXTENT OF OVERBURDEN APL PLUME
- AREAL EXTENT OF OVERBURDEN NAPL. PLUME
- ● — EXIST. OVERBURDEN SURVEY WELL
- ■ — OVERBURDEN APL SURVEY WELL
- ▲ — OVERBURDEN NAPL SURVEY BORING
- — — OVERBURDEN COLLECTION SYSTEM (CONCEPTUAL)

figure 5
OVERBURDEN PLUME SURVEY
HYDE PARK REMEDIAL PROGRAM

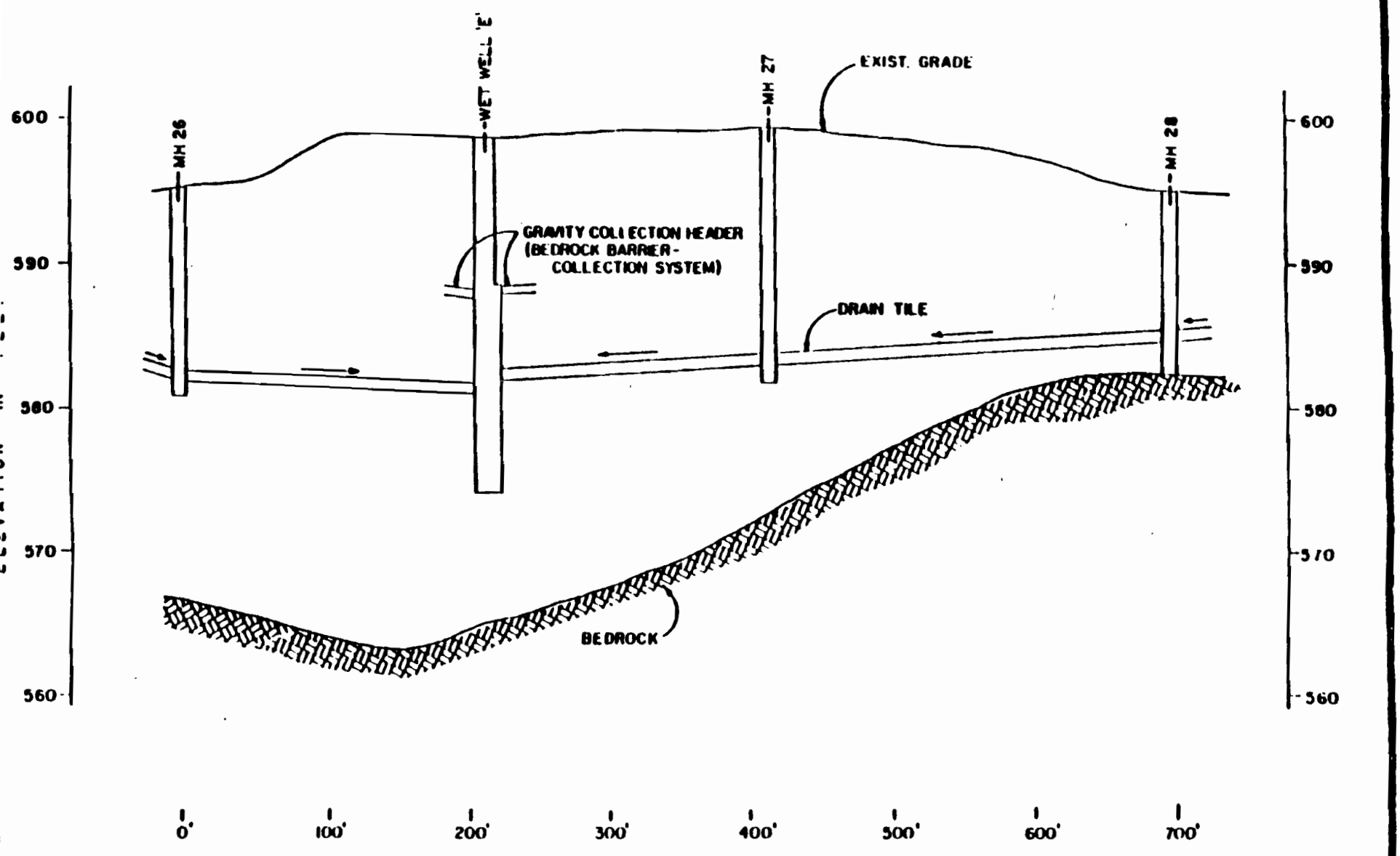
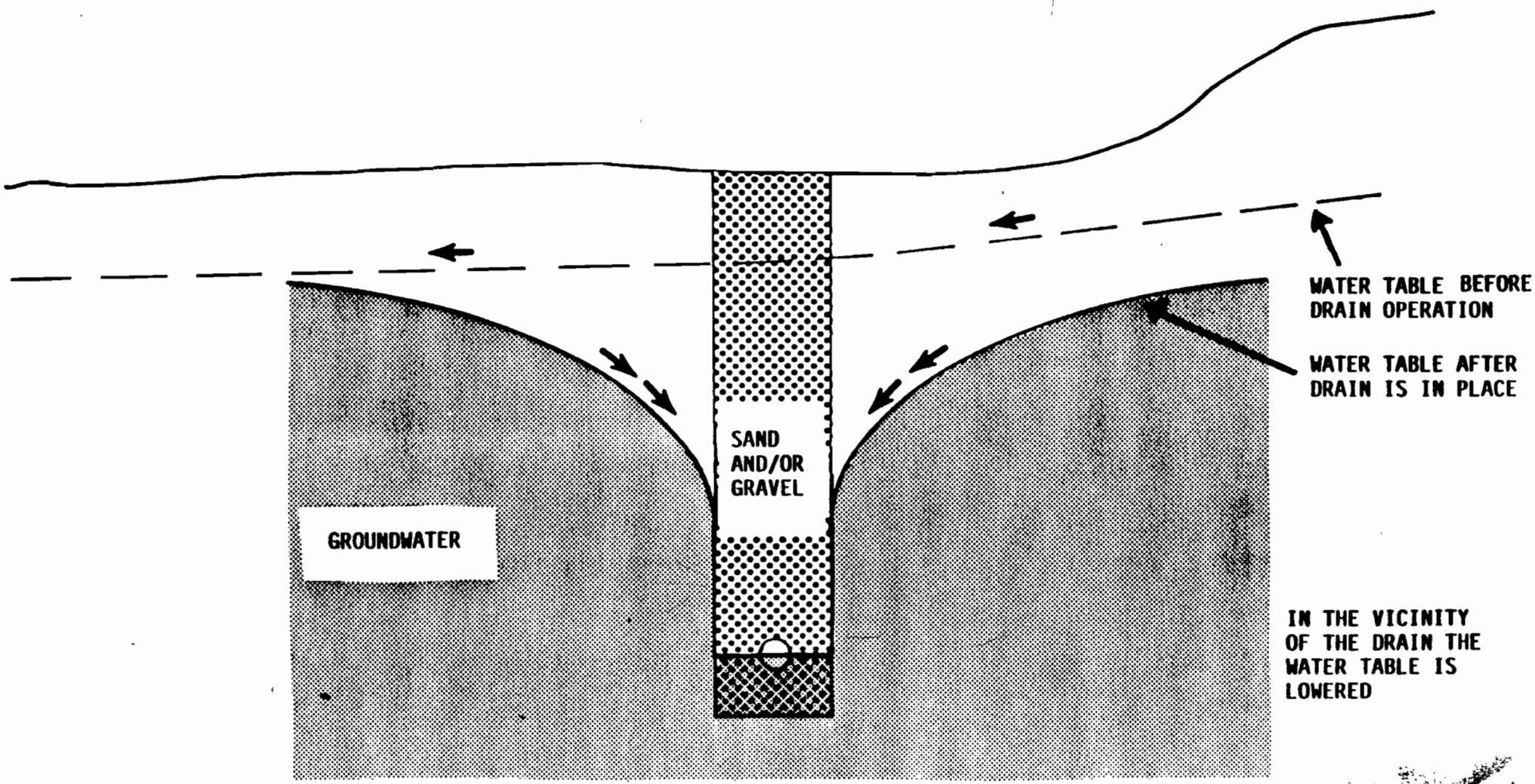


figure 6

OVERBURDEN BARRIER-COLLECTION SYSTEM
WEST PROFILE
Hyde Park-Bloody Run

FIGURE 7

CONCEPTUAL DRAWING OF A DRAIN
USED TO CONTROL GROUNDWATER MOVEMENT



SUMMARY

Description and Explanation of

Hyde Park Requisite Remedial Technology Program

Bedrock Remedies

January 30, 1986

1 INTRODUCTION

The Hyde Park Requisite Remedial Program requires an integrated system of remedial action, monitoring, and studies to address chemicals that are present in the bedrock layers below the site. Where chemicals are known to exist in the bedrock and present an endangerment to health and the environment, remedial actions are specified. In bedrock areas not addressed by remedial actions the groundwater will be monitored to determine if future actions will be required. Additionally, new wells and sampling are specified for studies to determine the extent to which chemicals have migrated below previously tested layers in the bedrock.

Bedrock Layers

Geologists classify distinct geologic layers as formations. (See figure 1). Below the Hyde Park Landfill the formations include from the top of bedrock down: the Lockport Dolomite, the Rochester Shale, the Irondequoit Limestone, Reynales Limestone, a sequence of sandstones and shales, and the Queenston Shale. All of these layers are exposed along the Gorge face next to Power Authority Access Road. Figure 1 shows a generalized diagram of the geologic layers below the site and their depths and orientation relative to the landfill and the gorge. Also shown in Figure 1 is the thin (5-30 feet thick) overburden layer of soils (sands, silt, and clay) that overlie the Lockport Dolomite.

Bedrock Studies

Studies have been undertaken to characterize bedrock properties and the nature of the contamination in the bedrock near the site. The most comprehensive study was performed by Occidental Chemical Corporation (OCC) in 1983 in accordance with the Hyde Park Settlement Agreement. This study involved the drilling of 49 holes into the Lockport Dolomite (the most significant water bearing bedrock layer in the Niagara Falls area). As the drilling went deeper, cores (samples of the bedrock) were taken, hydraulic tests were performed, and water samples were collected.

Observation during drilling of the fluids pumped, chemical analysis of water samples (about 300), and inspection of the cores confirmed that chemicals were present in two forms. Some chemicals are dissolved in the groundwater. Groundwater containing these chemicals is called APL (Aqueous Phase Liquids). Other chemicals that do not readily dissolve in groundwater formed a separate fluid called NAPL (Non-Aqueous Phase Liquids). In general, NAPL at Hyde Park is more dense than water--that is, it weighs about 80 pounds per cubic foot, whereas water weighs about 62.4 pounds per cubic foot. It is also more viscous than water (like molasses) and hence it moves more slowly in the pores and cracks of the soil and bedrock near the landfill.

Bedrock Contamination

The comprehensive survey performed by OCC in 1983 defined the extent of APL and NAPL in the bedrock formation known as the Lockport Dolomite. The extent is represented by the APL and NAPL plumes shown in Figure 2. In general, the chemicals have moved in all directions from the site with the highest level of APL contamination found to the northwest of the site. This was expected because groundwater in the Lockport Dolomite flows from the site to the gorge in a northwesterly direction. Contamination of groundwater to the east and south of the site is best explained by changes in groundwater flow patterns that occurred before and during construction (1958-1962) of the buried conduits which carry water from the upper Niagara River to the hydroelectric power project located on the lower Niagara River (see figure 1). The smaller size of the NAPL plume is expected because the more viscous nature of NAPL makes NAPL move slower than groundwater.

Groundwater in the bedrock layers near the landfill has a tendency to move downward as well as laterally toward the gorge. The downward movement is caused by the effects of the gorge which is about 300 feet deep and drains each permeable layer. Existing data on bedrock water quality is limited to the Lockport Dolomite. This data shows that Hyde Park chemicals in the form of APL and NAPL have reached the base of the Lockport Dolomite. The extent to which chemicals may have migrated in deeper layers, particularly the relatively impermeable Rochester Shale, is not known.

The programs that address contamination in the bedrock are described in detail in the Stipulation on Requisite Remedial Technology Program submitted to the United States District Court for approval on November 26, 1985. Other documents that discuss details of and requirements for the bedrock programs include affidavits submitted to the court by Dr. Faust and Dr. Shifrin.

In this document the general requirements and elements of bedrock remedial programs are summarized. These programs are the Lockport Bedrock RRT System, the Intermediate Formations Study, and the Deep Formations Study.

2 LOCKPORT BEDROCK RRT SYSTEM

The purposes of the Lockport Bedrock RRT System are to contain the lateral (outward) migration of NAPL and associated contaminated groundwater (APL) in the Lockport Dolomite near the landfill as well as contain APL in a designated area of the Lockport Dolomite. These areas include: (1) the area where NAPL is present (the bedrock NAPL plume) and (2) a specified area between the landfill and the gorge that contains the bulk of Hyde Park chemicals found beyond the NAPL plume. The systems used to provide this containment will at the same time remove contaminated groundwater and NAPL from the Lockport Dolomite. A specific objective of the system is to collect as much NAPL as is practicable. Additionally the systems will be operated so as to eliminate, to the extent practicable, seepage of chemicals at the gorge. To accomplish these goals, two seperate bedrock containment systems are specified in the Stipulation: the NAPL Plume Containment System and the APL Plume Containment System. The two containment systems will be monitored extensively to assure their effectiveness.

The two remedial systems specified in the Stipulation will be installed rather than the Bedrock Barrier Collection System (BBCS) required by the Hyde Park Settlement Agreement. The BBCS was designed only to control contamination in the uppermost portion of the Lockport Dolomite. Because contaminant migration is now known to extend to the base of the Lockport, the BBCS would not have been sufficient.

NAPL PLUME CONTAINMENT SYSTEM

What will this system address?

The NAPL Plume Containment System is an extremely important part of the overall remedial program required for the Hyde Park Landfill. Available data indicate that a significant portion (10-50%) of the 18,000 tons of liquid disposed at the landfill may have escaped to the bedrock layer. If left unremediated, contaminated groundwater and more importantly NAPL would continue to migrate slowly towards the Niagara River. The groundwater flow directions are indicated in Figure 3, which shows the elevation of groundwater levels from wells in the Lockport Dolomite. Groundwater flows from areas of high water levels to areas of low water levels. If the NAPL plume was not remediated, the contamination in the bedrock would continue to move over a much larger area then it currently does. Further, concentration of hazardous chemicals in groundwater reaching the seeps or Niagara River would continue to increase.

The primary objective of this part of the remedial program is to contain to the extent practicable, the NAPL plume as well as any APL within the NAPL plume. Additionally, the system will be designed and operated to maximize the collection of mobile NAPL.

How will this system work?

First, OCC is required to install wells to refine the extent of the NAPL plume in the Lockport. After this refinement, a prototype remedial system consisting of purge, recirculation and monitoring wells will be installed. This system will be considered a prototype because there is insufficient hydrogeologic data to design and implement a final system at this time. A final system will be designed based on an evaluation of the data collected during the prototype operation and the system's overall performance. The prototype approach will allow a remedy to be installed while simultaneously collecting the additional data required to design the final remedial program.

Initially, four purge wells will be installed to recover NAPL and APL within the NAPL plume. Purge wells will pump liquid out of the bedrock. The contaminated liquids will be separated, with the APL undergoing on-site treatment and the NAPL being removed for destruction by incineration. To enhance the recovery of NAPL, two recirculation wells are to be installed within the NAPL plume. A portion of the recovered APL will be reinjected into these wells to facilitate the removal of NAPL from the bedrock, pushing NAPL toward the pumping wells. This reinjection of APL will enhance the recovery of NAPL which is a major goal because NAPL contains chemicals in an undiluted form. Monitoring well clusters will be installed within the NAPL plume near the recovery and recirculation wells. These well clusters will be used to evaluate the effectiveness of the prototype pumping and recirculation program. The components of the prototype system are shown on Figure 4.

A final system which may include additional purge and recirculation wells will be based on the performance of this prototype system.

How will we know it works?

The final system will be monitored; hydraulically (water level measurements), to ensure that within the area which is to be contained the flow of groundwater is inward toward the landfill; chemically, to ensure that contaminated groundwater is not continuing to migrate out of the controlled area after the system has hydraulically stabilized; and, for physical evidence of NAPL. Monitoring wells which are part of this system will be located just within and outside the limits of the NAPL plume and are shown on Figure 5. EPA/State believe that this remedial technology is capable of meeting the objectives of the program. However, if the effectiveness monitoring reveals that the performance objectives are not being met, OCC will be required to modify or supplement its purge well system. If subsequent corrective actions are unsuccessful, OCC will be required to undertake an RRT Study to determine what remedial alternatives are requisite.

APL PLUME CONTAINMENT SYSTEM

What will this system do?

The approach to remediating the APL plume which is outside of the NAPL plume concentrates on the area where the greatest mass of contaminants have been identified. The chemical analysis of groundwater samples taken during the hydrogeologic investigation and from the seeps along the Niagara Gorge indicates that approximately 80 percent of the APL contaminants found outside of the NAPL plume are located in a portion of the bedrock between the landfill and the Niagara Gorge to the northwest (identified in Figure 6). The objectives of this remedial program are to contain and collect the APL within the area of greatest contamination and to eliminate to the extent practicable, the seepage of chemicals at the Gorge Face in the area of the remediated APL plume.

How will this system work?

OCC will be required to install and operate two purge wells near the Niagara Gorge. A third well will be installed upon request of EPA/State. The collected liquids will be transported by pipeline back to the landfill area for treatment. Four pairs of monitoring wells will be installed along the boundaries of the portion of the APL plume which OCC must control. Water elevations in these wells will be measured to ensure that groundwater levels within the control area are lowered sufficiently so that APL contaminants flow toward the purge wells. The components of the APL remedial program are shown in Figure 5.

Monitoring to Assess Chemical Loading to the Niagara River

Because the bedrock remedial programs will not completely eliminate chemical discharge to the Niagara River, chemical monitoring will be done at the purge wells along the edge of the Niagara Gorge to the northwest and at three wells which OCC will install west of the landfill. The purpose of this chemical monitoring is to more precisely evaluate the remaining loading of chemicals from

the bedrock to the Niagara River. If loadings (referred to as APL Plume Flux and described below) of particular toxic chemicals exceed action levels based on endangerment to human health and the environment, further actions will be taken to reduce the chemical loading.

A portion of the remaining APL plume which has been defined to the east and northeast of the landfill will be monitored hydraulically following the installation of three monitoring well clusters. The hydrogeology indicates that groundwater flows from this area to the west and northwest. These cluster monitoring wells will provide hydraulic data to assess the direction of groundwater flow (which is the direction the APL will move) on a frequent basis. The scope of this monitoring program is shown in Figure 7.

APL Plume Flux

The toxicity, chemical and physical properties, and quantity of the Hyde Park chemicals found in the APL plume were reviewed to identify those chemicals that may pose the greatest endangerment to human health and the environment or may significantly contribute to a violation of state water quality standards as they continue to discharge to the Niagara River. The chemicals selected as being of particular concern to Niagara River water quality are referred to as the APL Plume Flux Parameters. Those chemicals are TCDD (dioxin), PCB's, mirex, and chloroform.

For each selected chemical (parameter) there is a designated allowable residual flux (or loading) to the river in a unit such as pounds per day (Flux Action Level). To calculate the chemical flux to the river, concentrations of the contaminants will be measured in wells near the Niagara Gorge and the rate at which the contaminated groundwater discharges to the river will be determined.

If the total amount of one of the chosen chemicals entering the Niagara River exceeds a Flux Action Level four out of five consecutive quarterly monitoring periods, the NAPL and APL Plume Containment Systems will be modified as appropriate to reduce the flux. If the flux is not reduced, OCC will undertake an RRT Study and reassess Source Control including reassessing the need to excavate the landfill.

Available data indicate that operation of the APL Plume Containment System will serve to limit the flux of other chemicals in the APL Plume in addition to the APL Plume Flux Parameters. Periodic reassessments will be made to review the appropriateness of the APL Plume Flux Parameters and the corresponding Flux Action Levels. Reassessments enable the Governments to establish more stringent limits on the flux and to impose additional restrictions on other contaminants if necessary to protect public health and the environment.

An Interim Flux Level has been set for 2,3,7,8-TCDD (dioxin) and a special $1.33 million study will be conducted to assist in establishing the final 2,3,7,8-TCDD Flux Action Level. The primary purpose of this study will be to determine to what extent dioxin entering the Niagara River accumulates in fish. The governments of Canada and the Province of Ontario have been invited to participate in this study.

DURATION OF REMEDIAL PROGRAMS

The NAPL remedial system will be operated for a period of thirty-five years after the effective date of the Judgement (April, 1982) unless termination criteria are subsequently established and satisfied, or it is determined that continued operation is no longer requisite. However, no such determination can be made until 17 years following initiation of the prototype system. Operation of the program may be extended beyond 35 years if EPA/State show that continued operation is necessary to carry out the purposes and goals of the Judgment.

The APL remedial program will operate for a minimum of ten years. If it fails to meet the stated termination criteria it will continue to operate for five more years before any joint assessment is made on whether or not it is requisite to terminate the operation of the system.

The termination of the APL program will be followed by a period of post-termination monitoring. This monitoring will provide data to confirm that the objectives of the remedial program have been met. If chemical data obtained during post-termination monitoring indicates that termination criteria are no longer met, then OCC will be required to resume operation unless it can demonstrate that such resumption is not requisite.

At any time after termination of the APL or NAPL remedial programs, EPA/State have the right to demonstrate that resuming operation would be requisite.

3 STUDIES IN FORMATIONS BELOW THE LOCKPORT DOLOMITE

The APL and NAPL Plume Containment Systems address the potential for lateral migration of chemicals away from the Landfill. However, available data indicate that downward migration of chemicals may be occurring in the bedrock layers below the Lockport zolomite. The extent of chemical migration in these lower layers is not now known, because investigations have not been conducted in the lower formations. The groundwater in these lower bedrock formations (Intermediate & Deep) is expected to move laterally and downward toward the Niagara River. Therefore, if chemical contaminants have moved into these lower formations there is the potential for additional chemical loading to the river. If this additional loading itself or in combination with any remaining chemical loading from the Lockport Dolomite exceeds the established flux levels discussed above, appropriate remedial actions will be implemented to reduce the chemical loading.

The Stipulation includes two investigations that are intended to determine if chemicals have migrated below the Lockport Dolomite. The two investigations are called the Intermediate Formations Study and the Deep Formation Study. The Intermediate Formations Study will be performed in the Rochester Shale and Irondequoit/Reynales formations. The Deep Formation Study will extend to the top of the Queenston Shale (see Figure 1).

INTERMEDIATE FORMATIONS STUDY

Objective

The objectives of the Intermediate Formations Study are to determine if NAPL is present in the Rochester Shale, to determine the degree to which the Rochester Shale prevents or retards the downward migration of groundwater and chemicals, and to determine if chemicals from the Landfill are below the upper part of the Rochester Shale and, if these chemicals are present, in the Irondequoit/Reynales formations.

Study Description

The program requires the installation of seven permanent monitoring wells in the Irondequoit/Reynales formations as shown in Figure 8. To install the wells, OCC will first drill through the Rochester Shale. Groundwater sampling, inspections for NAPL, and permeability testing will be conducted in the core-holes in the Rochester Shale. The monitoring wells are located outside the presently defined boundary of the NAPL plume in the Lockport Dolomite. The reason for locating wells outside the NAPL plume is that no drilling protocols and well construction methods are available that would totally preclude the possibility of cross contamination of the lower formation where a dense NAPL is present in a higher formation. Cross-contamination could result in a finding of chemicals in a lower formation; not because of the APL or NAPL migrating through the bedrock, but because of NAPL from the upper bedrock formation being carried to the lower formation by the drilling process.

The absence of detectable levels of the Lower Formation Survey Parameters (see Section 9.5 of the Stipulation) in groundwater samples taken from the monitoring wells will provide a strong indication that NAPL has not yet reached the Intermediate Formations. If NAPL were present in the Intermediate Formations, it would provide a source of chemicals to dissolve at low concentrations in a very large volume of ground water. Because of the low detection levels and appropriateness of the Lower Formation Survey Parameters and the well locations, any significant contamination of ground water associated with NAPL would be detected by the monitoring program for the Intermediate Formations.

If no survey parameters are found during the initial surveys of the Intermediate Formations, then monitoring will be continued twice a year for two years and on an annual basis thereafter to confirm that leakage is not occurring. If the Lower Formation Survey Parameters are not detected in the groundwater and NAPL is not found in the Intermediate Formations, this information will provide the basis for concluding that chemicals are not entering the Niagara River from these and deeper formations.

If survey parameters are found in the Intermediate Formations either during the initial surveys or subsequent monitoring, then an assessment is required to determine what additional remedial actions must be taken. This assessment will be based on calculations of long-term loadings of "APL Plume Flux Parameters"

(TCDD, mirex, PCB's and chloroform) to the Niagara River. Such calculations will include a sum of the loadings from the Intermediate Formations and the Lockport Dolomite which will then be compared to the APL Plume Flux Action Level (discussed previously), to determine if remedies are necessary.

The Stipulation requires OCC to make the loading calculations and to implement specified actions based on the flux levels. The specified remedies include modifications such as increased pumping or, if necessary, additional purge wells in the existing APL and NAPL Plume Containment Systems or in the Intermediate Formations. Because the total loading to the river is the basis for evaluating endangerment and because it is more efficient to implement remedies in the Lockport Dolomite than in the lower formations, initially additional corrective actions may be implemented in the Lockport Dolomite. Only in the event that the specified remedies do not reduce loading levels or contain NAPL will an RRT study be performed.

Deep Formations Study

The Stipulation requires the Deep Formation Study only if Lower Formation Survey Parameters are found in the Intermediate Formations. Also, one of three other conditions must occur: (1) the flux (loading) from the Lockport Dolomite is greater than 70 percent of the APL Plume Flux Action Level; (2) the sum of the flux from the Intermediate Formations and the flux estimated for the Deep Formation exceeds 50 percent of the APL Plume Flux Action Levels (the flux of the Deep Formation is estimated by multiplying the flux in the Intermediate Formations times the ratio of thickness of the Deep Formations to the thickness of the Irondequoit/Renayles Formation); (3) the sum of the flux from the Lockport Dolomite, the flux from Intermediate Formations, and the flux estimated for the Deep Formations exceeds 100 percent of the APL Plume Flux Action Levels. If Survey Parameters are found in the Intermediate Formations and one of these conditions exists, then three wells must be installed either 10 feet into the Queenston Shale or to the Niagara River level, whichever is higher. During the initial survey the groundwater will be sampled and analyzed for Lower Formation Survey Parameters (Section 9.5 of the Stipulation), the core (rock) samples will be inspected for NAPL, and permeability tests will be performed.

If no Survey Parameters are found during the initial surveys in the deep formations, the three wells will continue to be chemically monitored twice a year for two years and yearly for the next three years. If the Survey Parameters are found above Survey Levels in any of the original three wells, OCC will install an additional three wells, sample these wells, and calculate the loading of the APL Plume Flux Parameters to the river from the Deep Formations. If the sum of fluxes (loadings) from the Lockport Dolomite, Intermediate Formations, and Deep Formations exceed the APL Plume Flux Action Level, OCC is required to reduce the loading of these chemicals to below the Flux Action Level in the same manner as described for the Intermediate Formation above, including installation of purge wells in the Deep Formations, if necessary. If the total loading of the APL Plume Flux Parameters is not reduced below the APL Plume Flux Action Levels or if NAPL is found, then OCC must perform an RRT study.

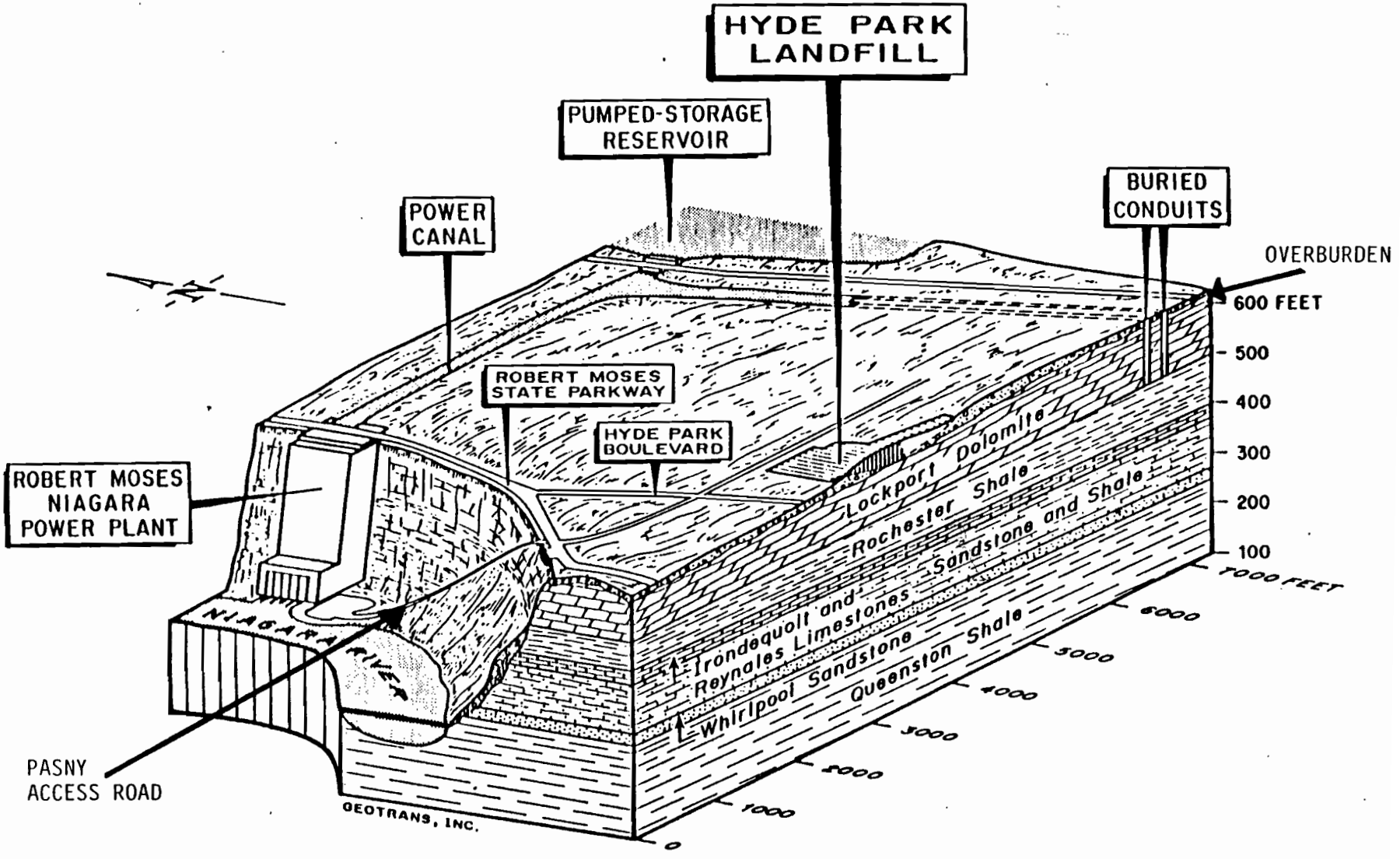


Figure 1. Generalized diagram showing the geologic formations and tonographic features in the vicinity of the Landfill.

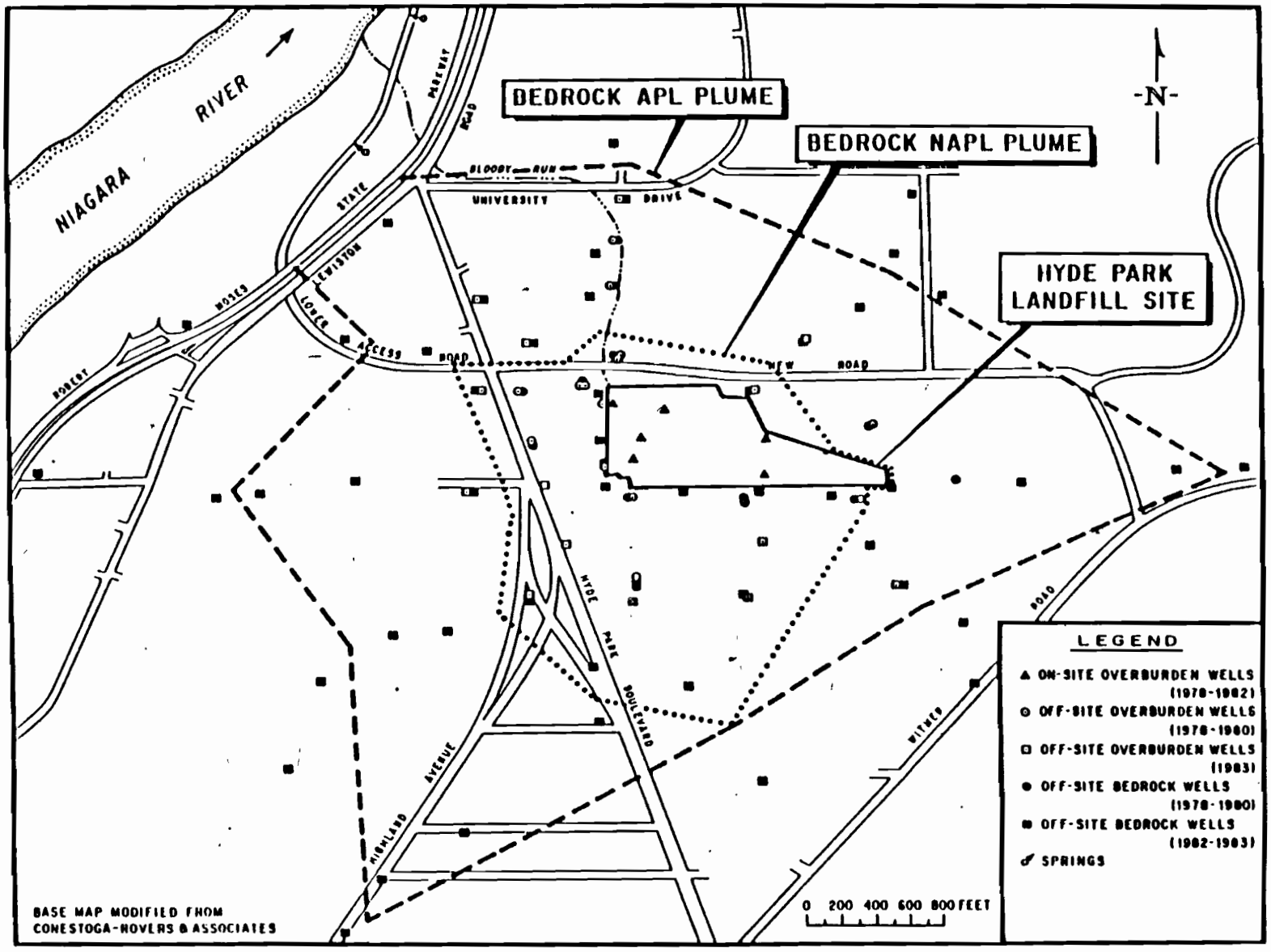


Figure 2 . Lockport Dolomite plumes as defined by the Hyde Park surveys in accordance with the Settlement Agreement (December 1982 - May 1983). Lockport Dolomite is the first layer of bedrock below the overburden.

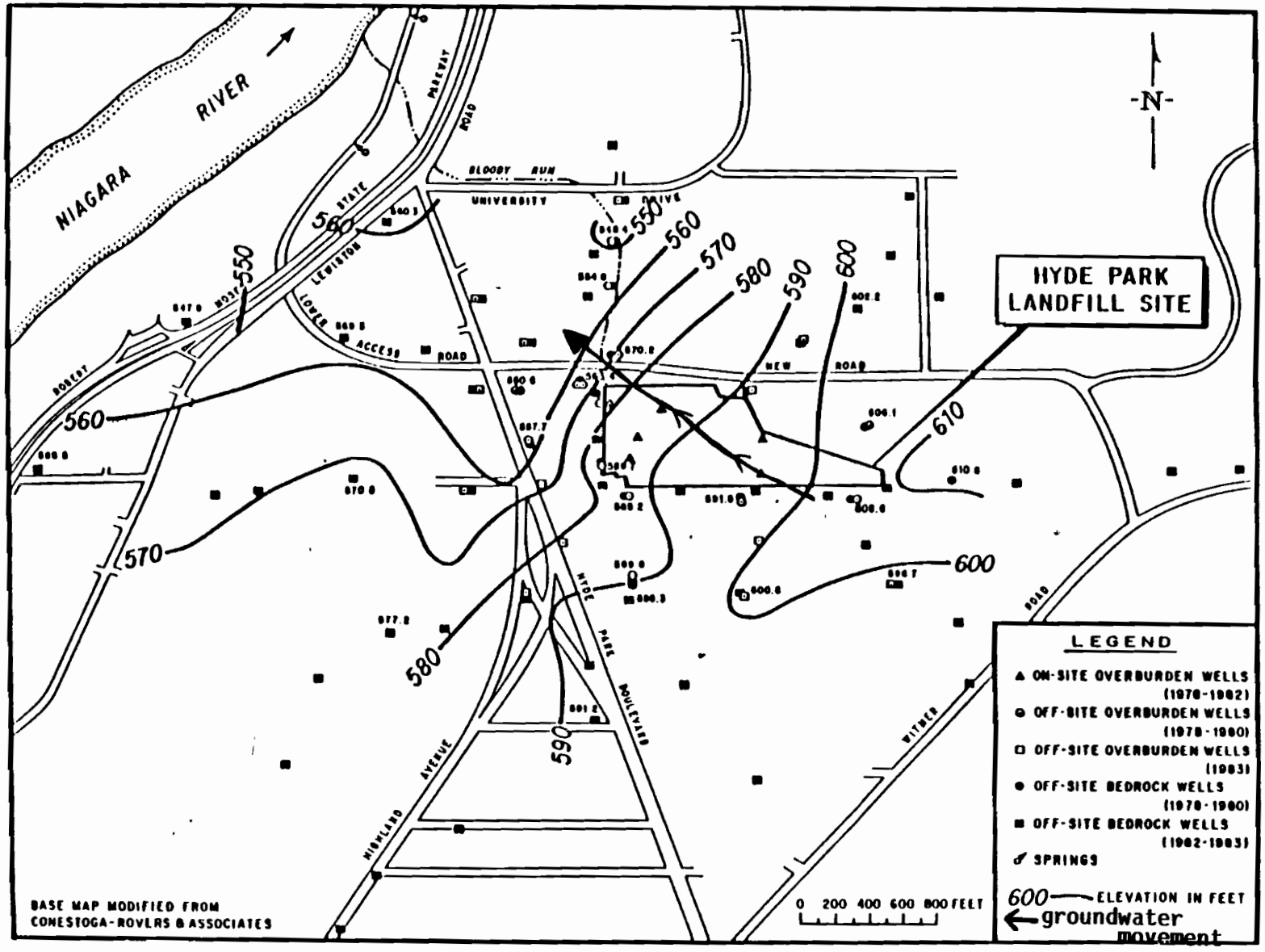


Figure 3. Ground-water elevations in the Lockport Dolomite (January 20, 1983). The groundwater elevations are highest east of the landfill and decrease as you move toward the gorge. Lateral groundwater movement is northwest toward the gorge face.

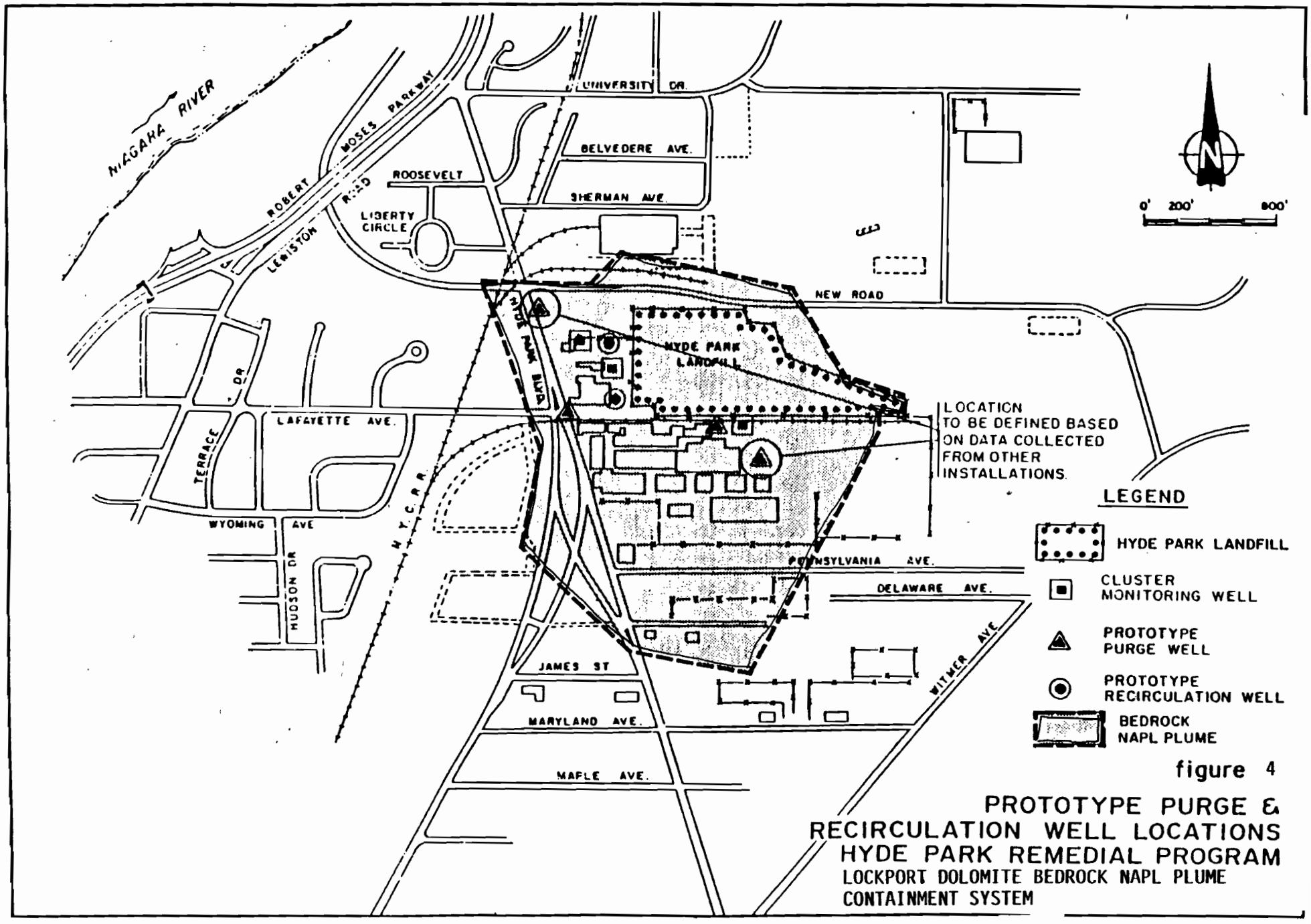


figure 4

PROTOTYPE PURGE & RECIRCULATION WELL LOCATIONS
HYDE PARK REMEDIAL PROGRAM
LOCKPORT DOLOMITE BEDROCK NAPL PLUME CONTAINMENT SYSTEM

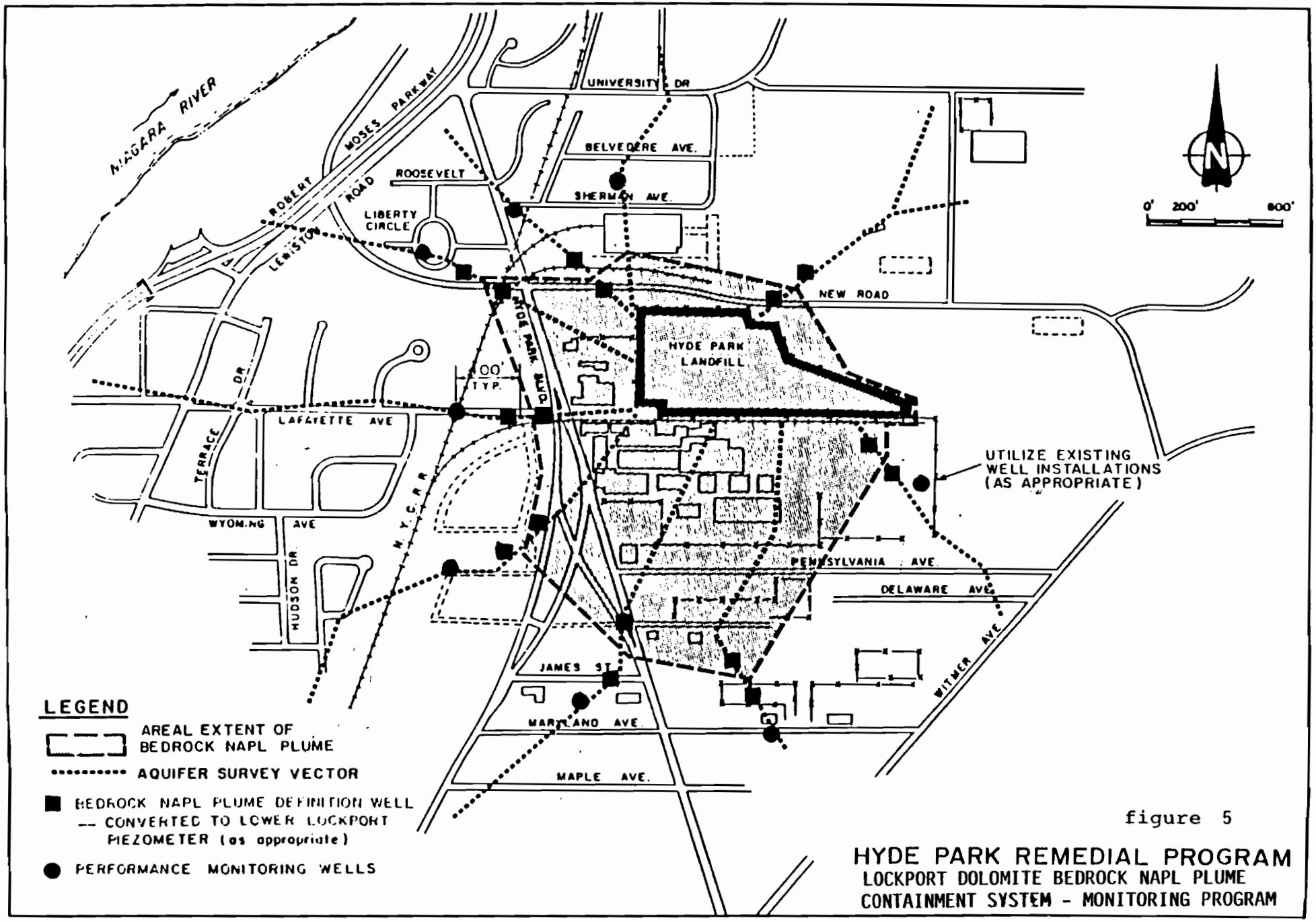


figure 5

HYDE PARK REMEDIAL PROGRAM

LOCKPORT DOLOMITE BEDROCK NAPL PLUME CONTAINMENT SYSTEM - MONITORING PROGRAM

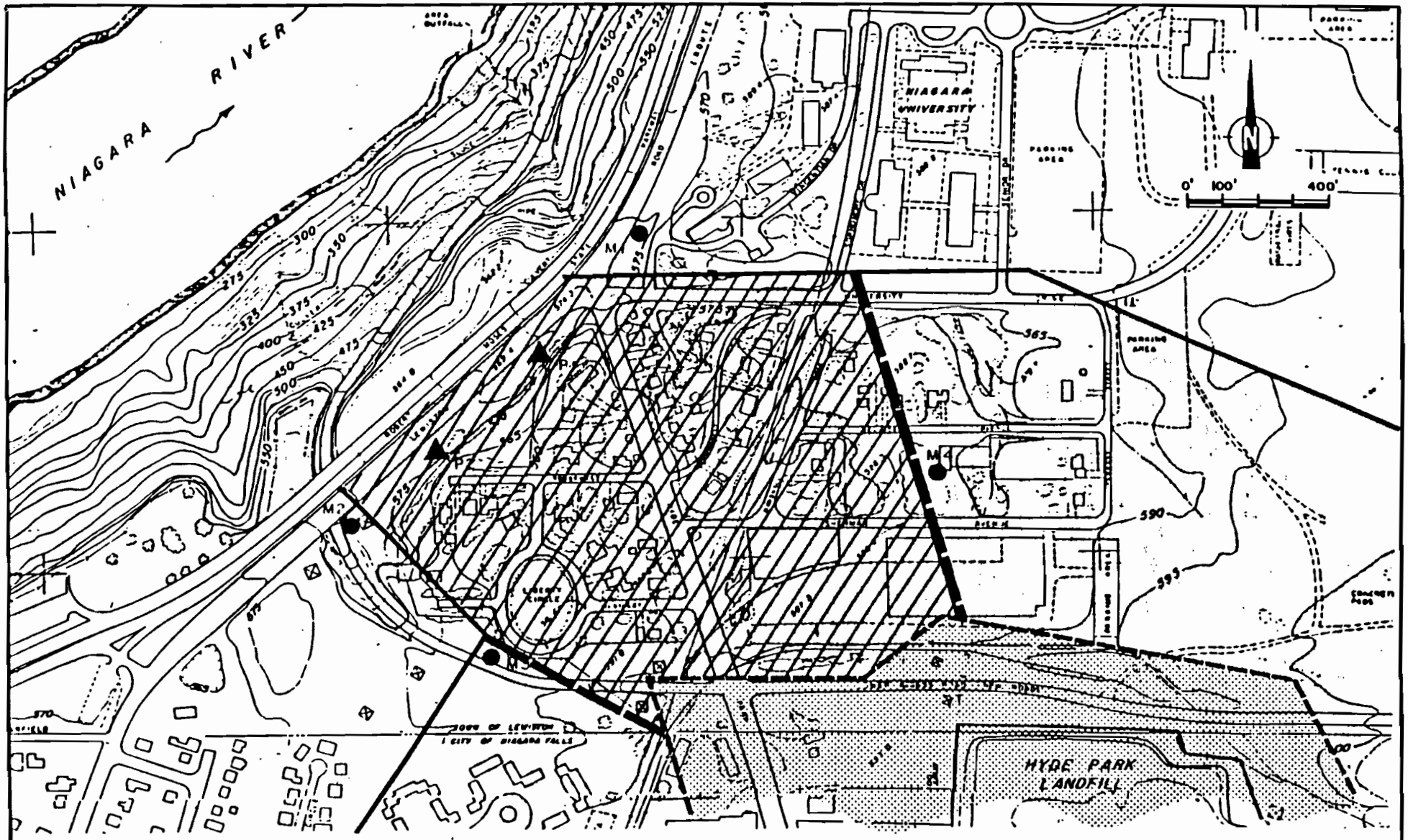


figure 6

LOCKPORT DOLOMITE BEDROCK APL PLUME
CONTAINMENT SYSTEM MONITORING
HYDE PARK REMEDIAL PROGRAM

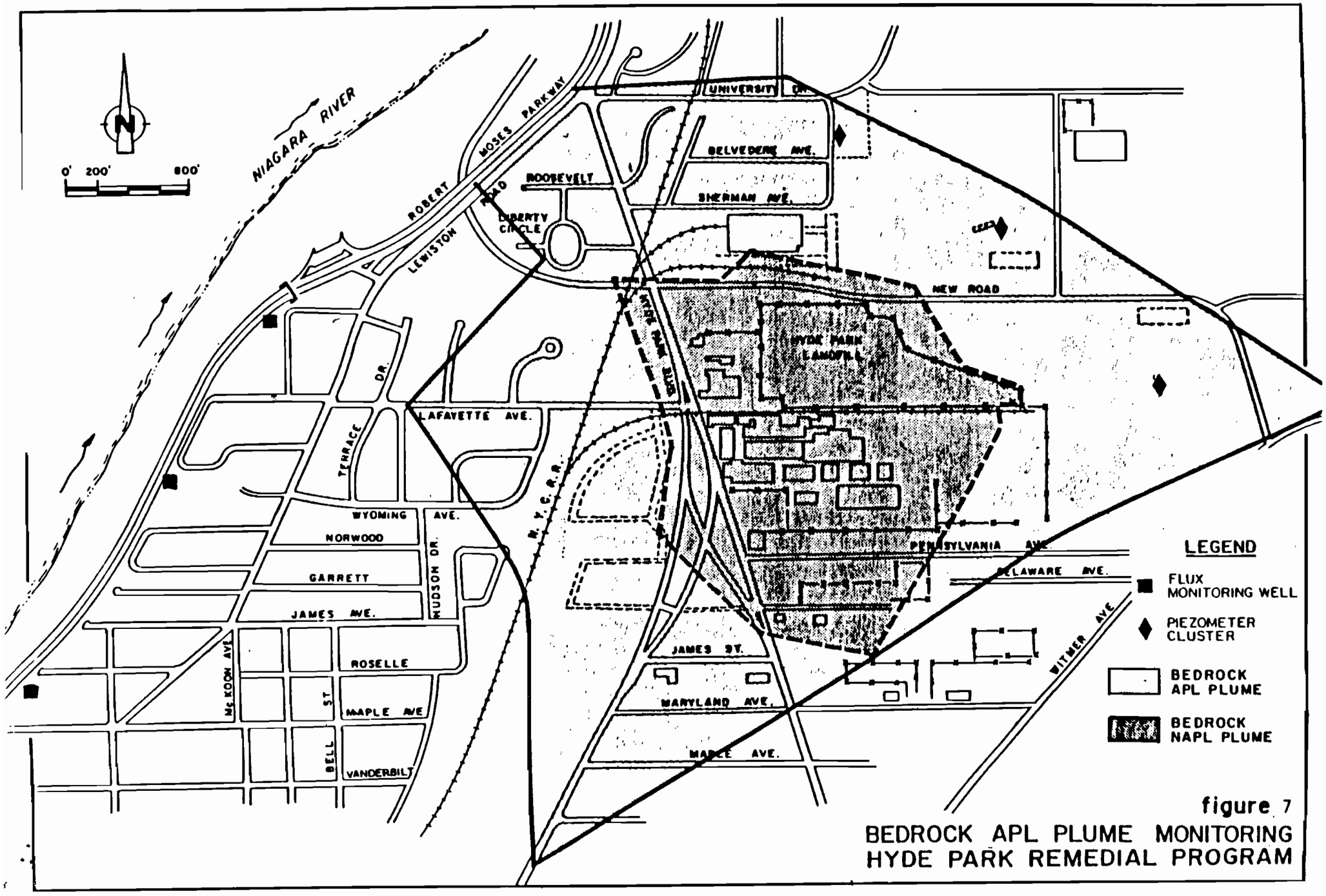


figure 7

BEDROCK APL PLUME MONITORING
HYDE PARK REMEDIAL PROGRAM

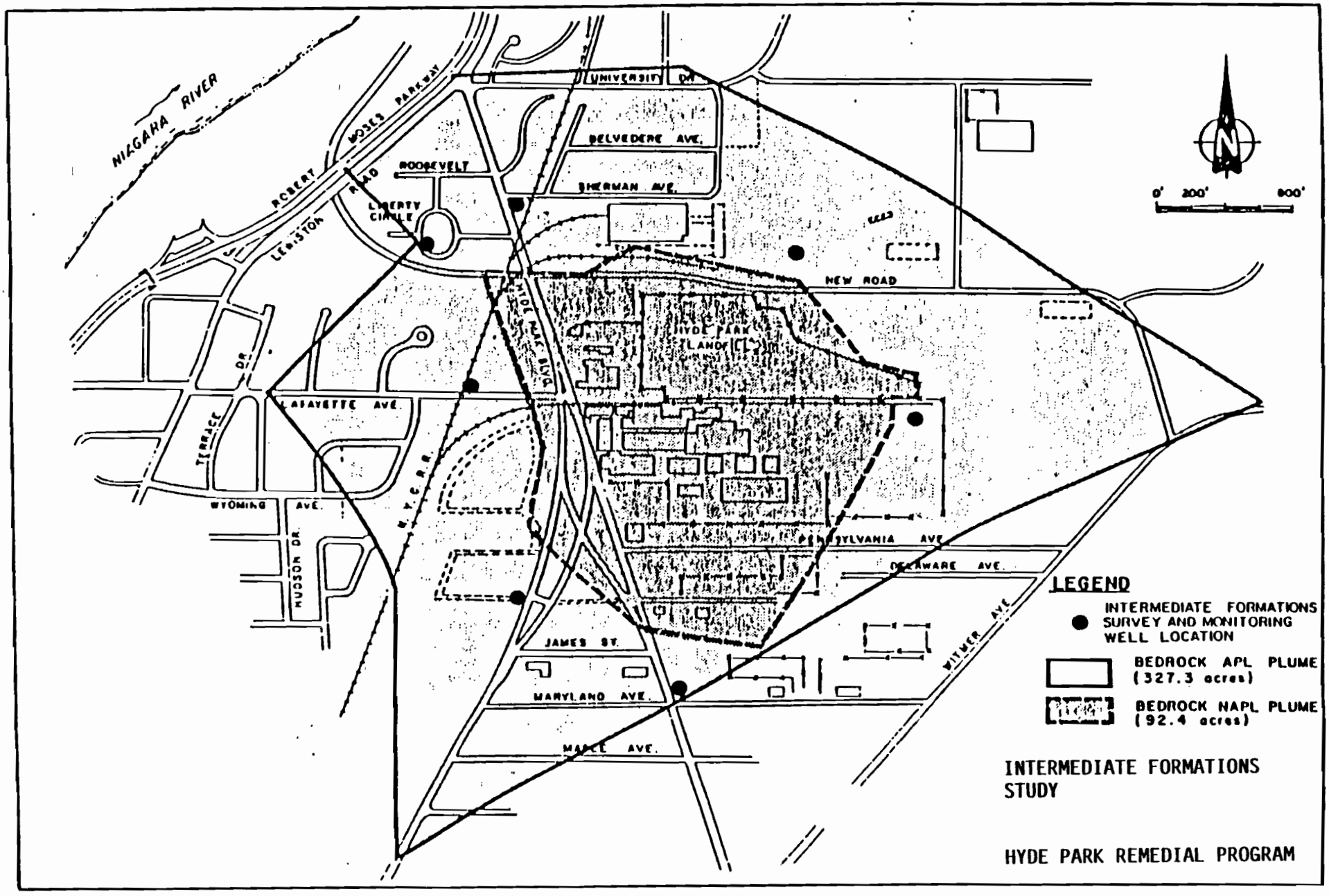


Figure 8 . Monitoring wells planned for intermediate formations.